Aviation Week and Space Technology

A McGraw-Hill Publication

May 15, 1961

SPECIAL REPORT:

Light Aircraft At British Show

General Electric Plug Nozzle Engine Firing

From Aerojet's

Propulsion for
TITAN, DYNA-SOAR,
ADVANCED PROJECTS

The missile: TITAN I, shown here in its first stage-separation flight. The power plants: liquid-propellant rocket engines—designed, developed, and manufactured by Aerojet-General's Liquid Rocket Plant.

Supplier of engines for TITAN I and II, DYNA-SOAR, and BOMARC, the Liquid Rocket Plant is the nation's largest fully integrated facility for the research, development, and production of liquid rocket engines.

- In-Space Rocket Engines
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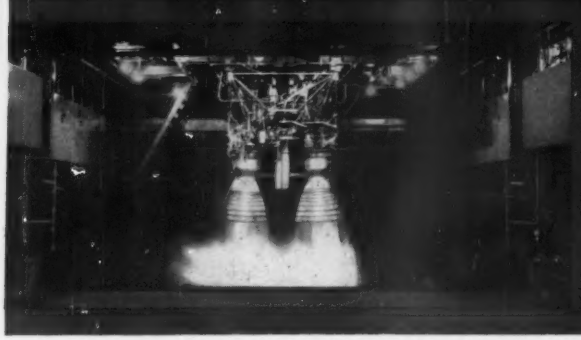
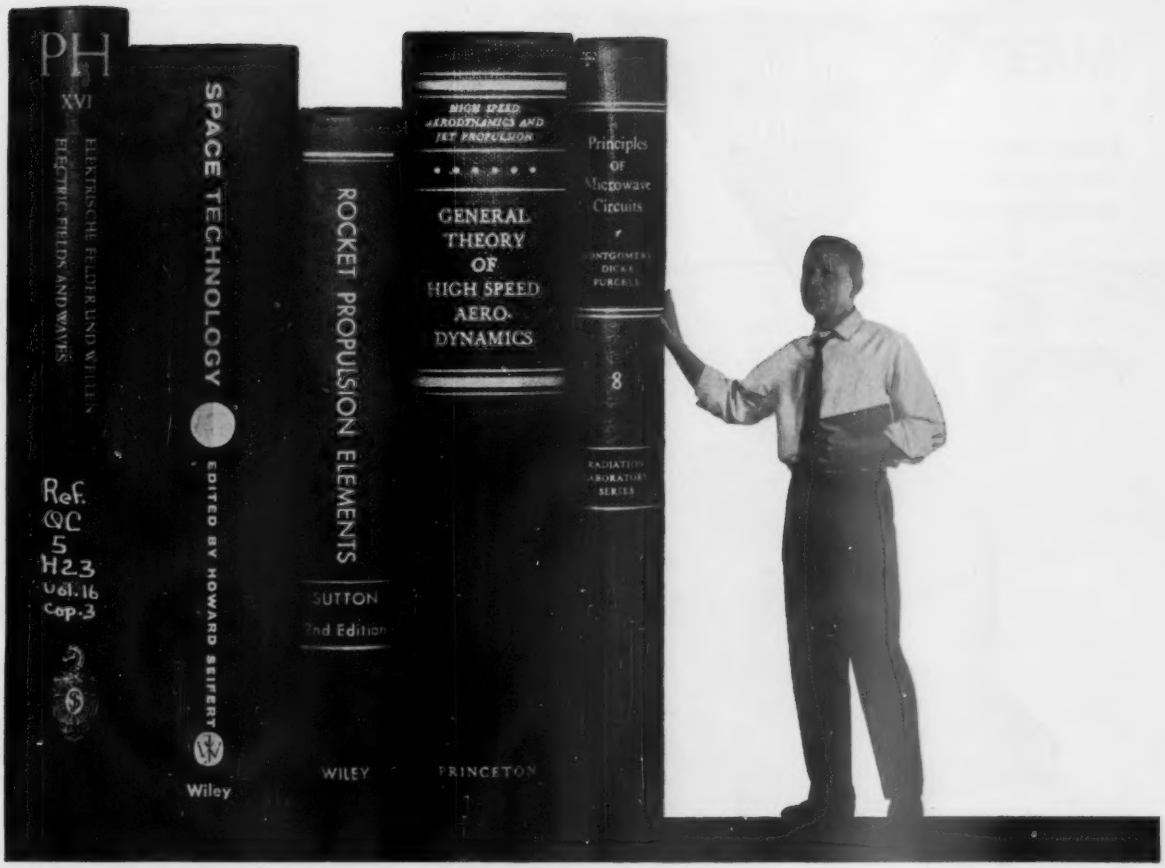


Engineers, scientists—investigate outstanding opportunities at Aerojet



space systems planning and engineering in a unique role

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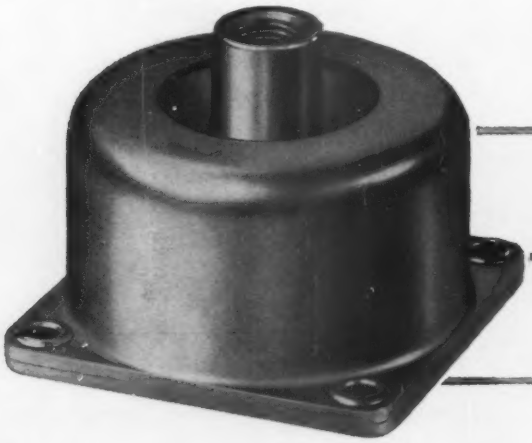
another advance in

vibration/shock/noise control



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AVIATION CALENDAR

May 22-24—National Telemetering Conference, Sheraton-Towers Hotel, Chicago, Ill.

May 22-24—Fifth National Symposium on Global Communications, Institute of Radio Engineers, Hotel Sherman, Chicago.

May 23-25—Quarterly Conference, Society of Automotive Engineers' Military Ground Support Equipment Committee, Continental Hilton Hotel, Mexico City.

May 23-25—Symposium on Large Capacity Memory Techniques for Computing Systems, Information Systems Branch—Office of Naval Research, Washington, D. C.

May 23-27—Navy League Convention and Air-Seapower Symposium, Washington.

May 26-27—First National Conference on the Peaceful Uses of Space, Tulsa, Okla. Sponsors: NASA; Tulsa Chamber of Commerce.

May 26-June 4—24th French International Air Show, Le Bourget, Paris, France.

May 27-30—13th Annual Wright Memorial Glider Meet, Dayton, Ohio.

May 31-June 2—University of Michigan's Seventh Annual Radar Symposium, Ann Arbor, Mich.

June 2-3—12th National Maintenance and Operations Meeting, Reading Aviation Service, Inc., Reading, Pa.

June 6-7—Air Transport Section, National Safety Council, Executive Committee Meeting, Lambert Field, St. Louis, Mo.

June 6-8—International Instrument-Automation Conference & Exhibit, Instrument Society of America, Royal York Hotel, Toronto, Canada.

June 6-11—Golden Anniversary of Naval Aviation, Pensacola, Fla.

June 13-15—National Joint Meeting, In-

(*Continued on page 6*)

AVIATION WEEK and Space Technology

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Vol. 74, No. 20

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*Patent No. 2931532

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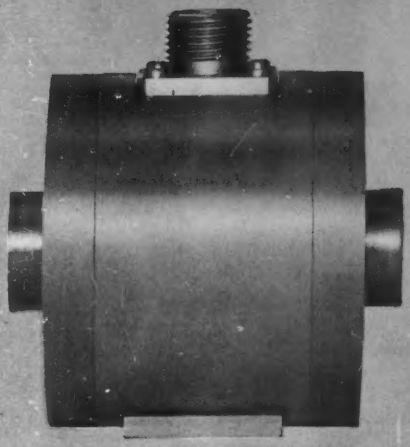

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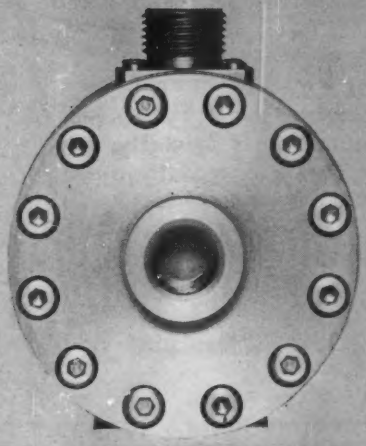

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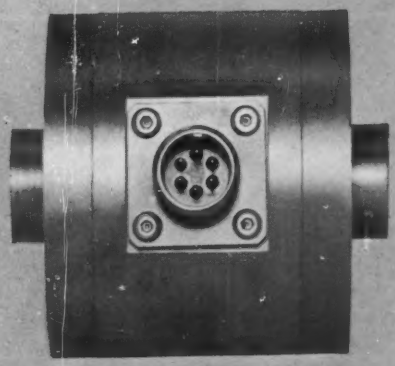
For complete information, call your nearest CEC sales and service office or write for Bulletin CEC 4351-X2.



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AVIATION CALENDAR

(Continued from page 5)

stitute of the Aerospace Sciences and American Rocket Society, Ambassador Hotel, Los Angeles, Calif.

June 13-15—37th Meeting, Aviation Distributors and Manufacturers Assn., Dennis Hotel, Atlantic City, N. J.

June 14-15—Fifth Annual Conference, Product Engineering and Production, Institute of Radio Engineers, Sheraton Hotel, Philadelphia, Pa.

June 19-21—Space Flight and Re-entry Trajectories Symposium, International Astronautical Federation's International Academy of Astronautics, Paris, France.

June 19-21—Institute of Navigation—USAF Symposium on Supersonic Air Transport Navigation, Western Hills Hotel, Ft. Worth, Tex.

June 22-23—Eighth Annual Symposium on Computers and Data Processing, Denver Research Institute, Elkhorn Lodge, Estes Park, Colo.

June 26-28—Fifth National Convention on Military Electronics, Institute of Radio Engineers, Shoreham Hotel, Washington.

June 26-28—European Symposium on Space Technology, British Interplanetary Society, London, England.

June 26-30—Special Technical Conference, American Institute of Electrical Engineers' Aerospace Transportation Committee, Benjamin Franklin Hotel, Philadelphia.

June 27-29—International Symposium on Analytical Astrodynamics, Santa Barbara, Calif. (Contact: Capt. J. L. Gilbert, Air Force Office of Scientific Research, Washington 25, D. C.)

June 28-30—Joint Automatic Control Conference, University of Colorado, Boulder.

June 28-July 1—Annual Meeting, Institute of Navigation, Williamsburg Inn, Williamsburg, Va.

July 17—Air Force Contract Aviation Services Symposium, National Aeronautical Services Assn., Hotel Washington, Washington, D. C.

July 24-26—Air Traffic Control Facilities Symposium, Electronic Maintenance Engineering Assn., Mayflower Hotel, Washington, D. C.

July 25-Aug. 10—International Trade Fair and Aviation Exhibition, McCormick Place Exposition Center, Chicago, Ill.

Aug. 1-3—Fourth Western Regional Meeting, American Astronautical Society, Sheraton-Palace Hotel, San Francisco, Calif.

Aug. 7-9—Guidance and Navigation Conference, American Rocket Society, Stanford University, Palo Alto, Calif.

Aug. 22-25—Western Electronic Show and Convention, Cow Palace, San Francisco.

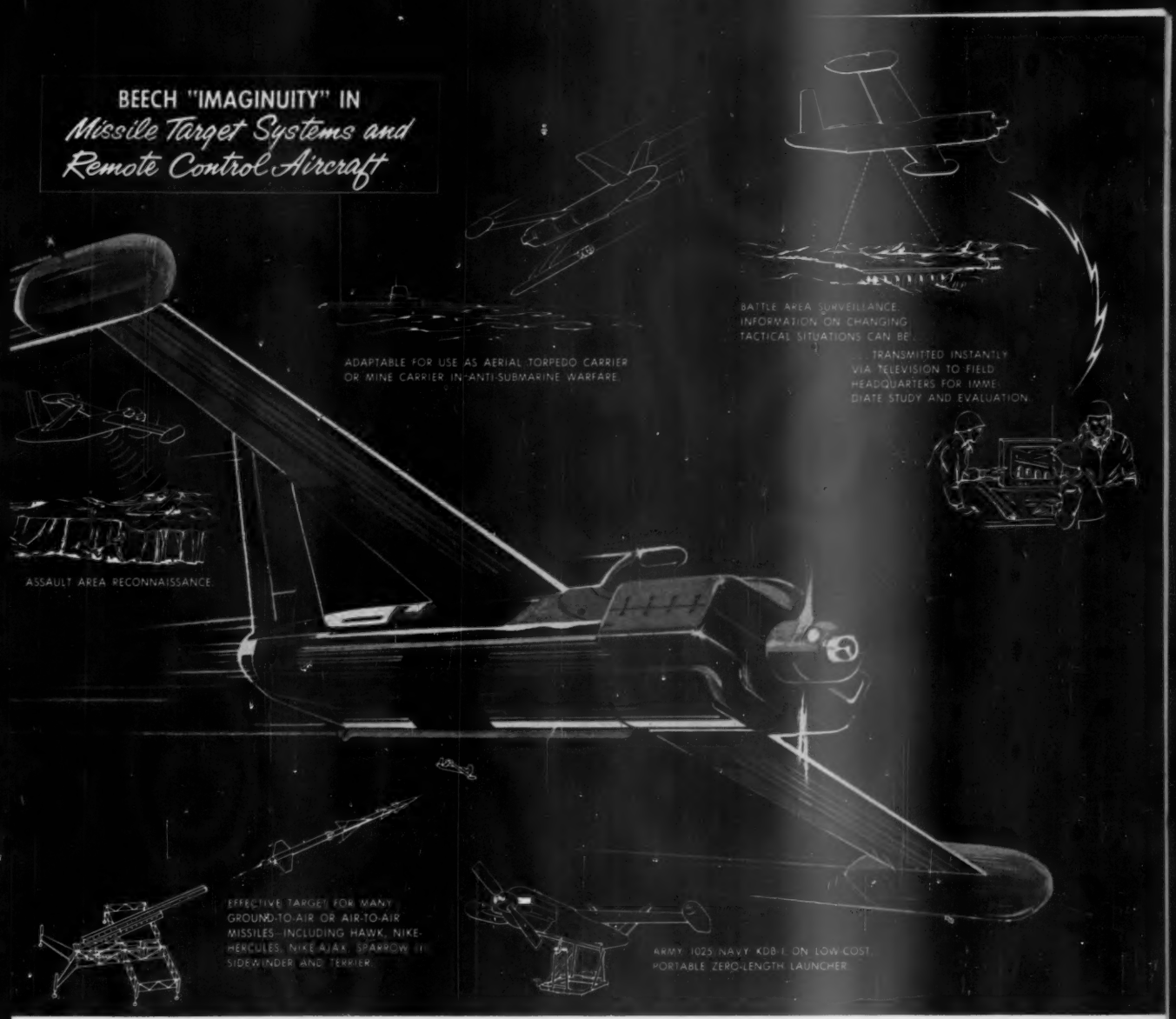
Sept. 4-10—1961 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 6-8—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, University of New Mexico, Albuquerque, N. M.

Sept. 10-12—National Convention, National Aeronautic Assn., Westbury, N. Y.

Oct. 2-7—12th International Astronautical Congress, Washington, D. C.

Oct. 9-13—American Rocket Society's 16th Annual Meeting & Space Flight Report to the Nation, Coliseum, New York, N. Y.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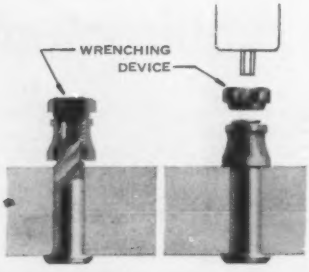

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Contact your Engineering Standards Group, VSMF Microfilm Catalog File, or write to us directly for additional information on Hi-Loks.

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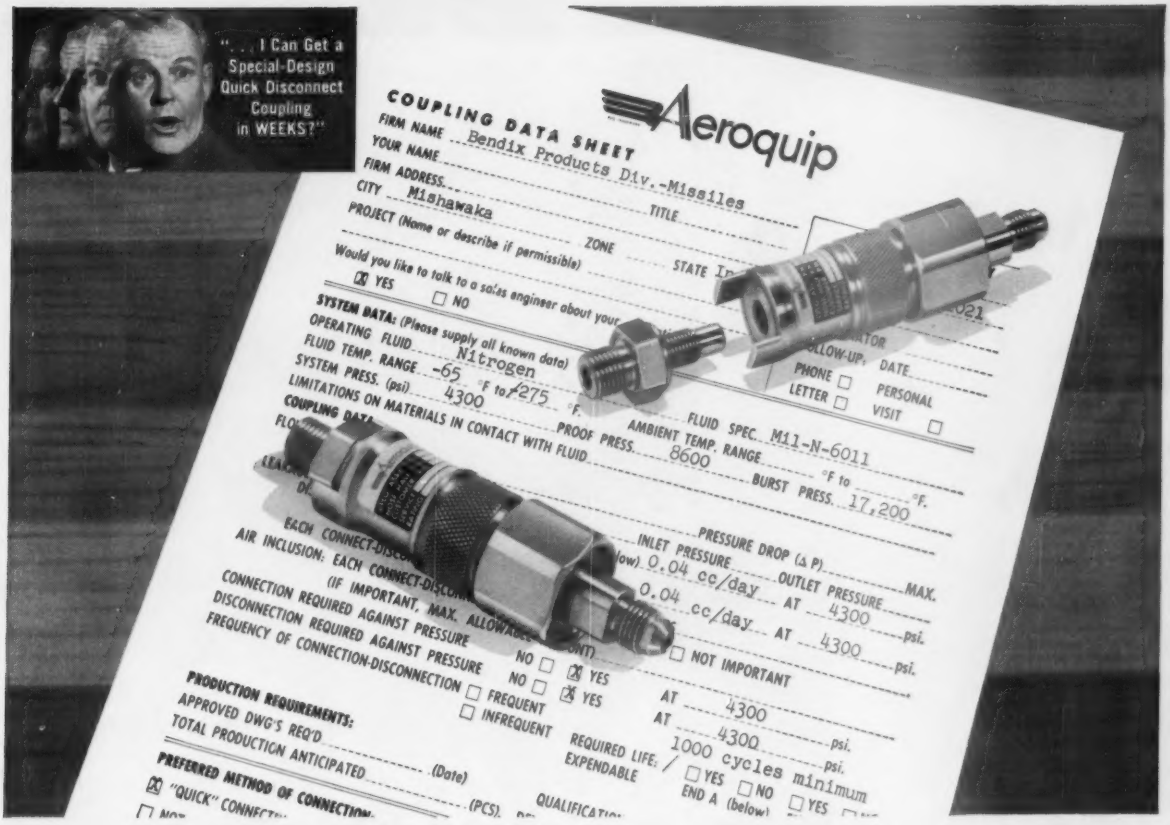

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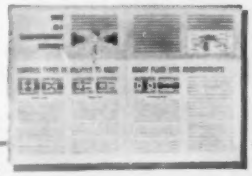

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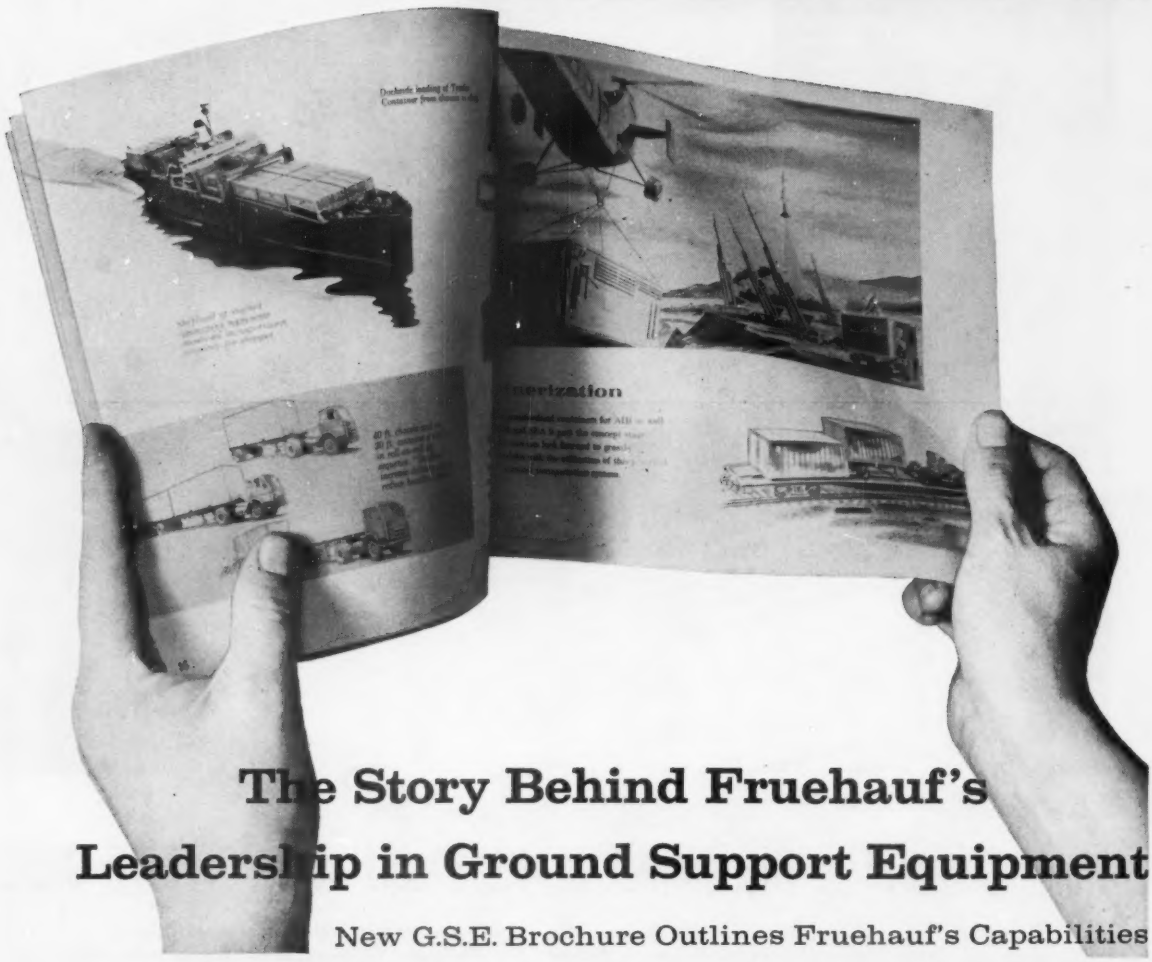

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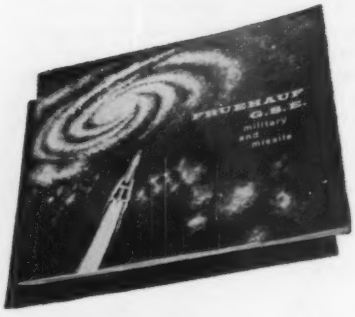

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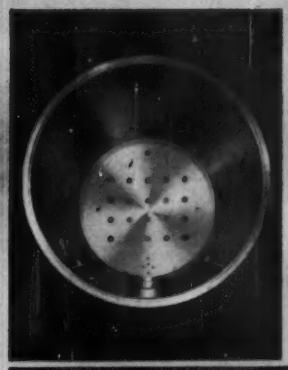
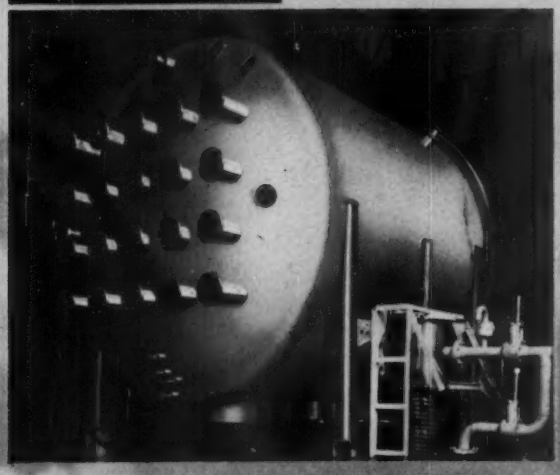
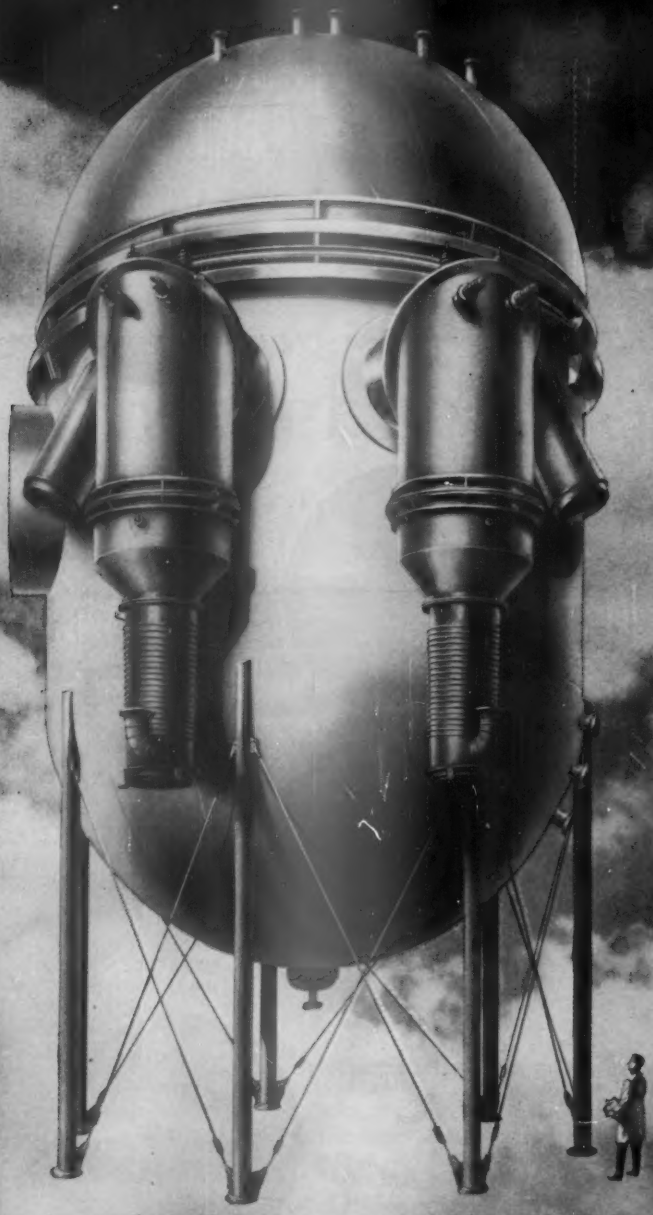


FOR CHANCE VOUGHT DALLAS

(Tenney Engineering, Inc.)

This polished chamber of stainless steel for Chance Vought's orbital simulation is 12 ft dia x 16 ft long. In service, pressure will be reduced to 1×10^{-7} mm Hg, or 1,100,000 ft. Lower photo shows mass spectrometer testing.





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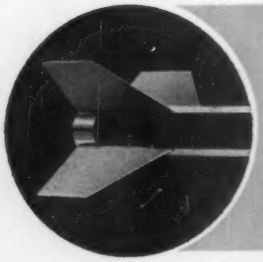
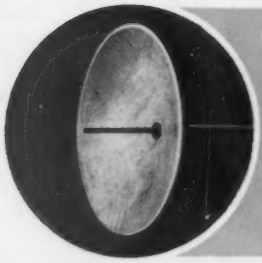
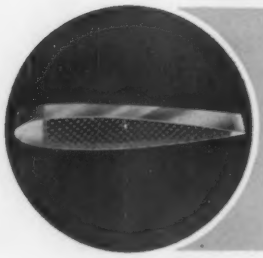


MISSILE AIRFRAMES AND BODY SECTIONS, such as this Rohr-built missile fin, can be made better and faster with bonded structures. Ideal strength/weight ratios, cleaner aerodynamic surfaces, better structural integrity for exposure to sonic vibration and long stand-by periods, lower tooling and production costs . . . just a few of the superior qualities of bonding.



RADAR REFLECTORS AND ANTENNAS are among the precision products made better by bonding. No other method provides such dimensional stability and accuracy, plus light weight and fine surface finish.



HELICOPTER BLADES, too, can be made from new bonding methods and materials developed by Rohr. The blade section illustrated is made with non-perforated honeycomb core . . . a technique which is also ideal for aircraft control surfaces.

These examples are but a few of the many ways that metal bonding is doing a better job. For more information about this, or other Rohr capabilities, write Mr. A. R. Campbell, Sales Manager, Department 40, Rohr Aircraft Corporation, Chula Vista, California

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Insulation News from Johns-Manville

Min-K® soars through space –and back!

J-M INSULATION, WITH $\underline{k}$ LOWER THAN THE MOLECULAR CONDUCTION OF AIR, SHIELDS AGAINST EXTREMES OF HEAT AND COLD

As the Mercury Space Craft is launched, orbits and is recovered, exterior temperatures range from around –100F to plus 1600F. Yet, only inches away, inside the space vehicle, temperatures never fall below or exceed comfort and health levels. The reason? Two Johns-Manville insulations, selected by McDonnell Aircraft Corporation and the NASA, are doing their job to perfection. They are the *only* thermal insulations used in the space craft.

One of these is Min-K, the super insulation for critical areas. This unique material exhibits a marked reduction of thermal conductivity as atmospheric pressure decreases. Min-K also possesses a thermal diffusivity lower than ordinary materials which weigh five times as much. Thus, it is possible to control thermal transients at a fraction of such weights.

For other sections of the Space Craft, where controlled heat flow was necessary, J-M Thermoflex RF Felt was used. Together, the Johns-Manville insulations make up a team that helps solve the space travel problem.

Solving insulation problems is a Johns-Manville specialty. For assistance on *your* problems, details on Min-K and other J-M aviation insulations, write J. B. Jobe, Vice-President, Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ontario. Cable address: Johnmanvil.

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JOHNS-MANVILLE JM PRODUCTS

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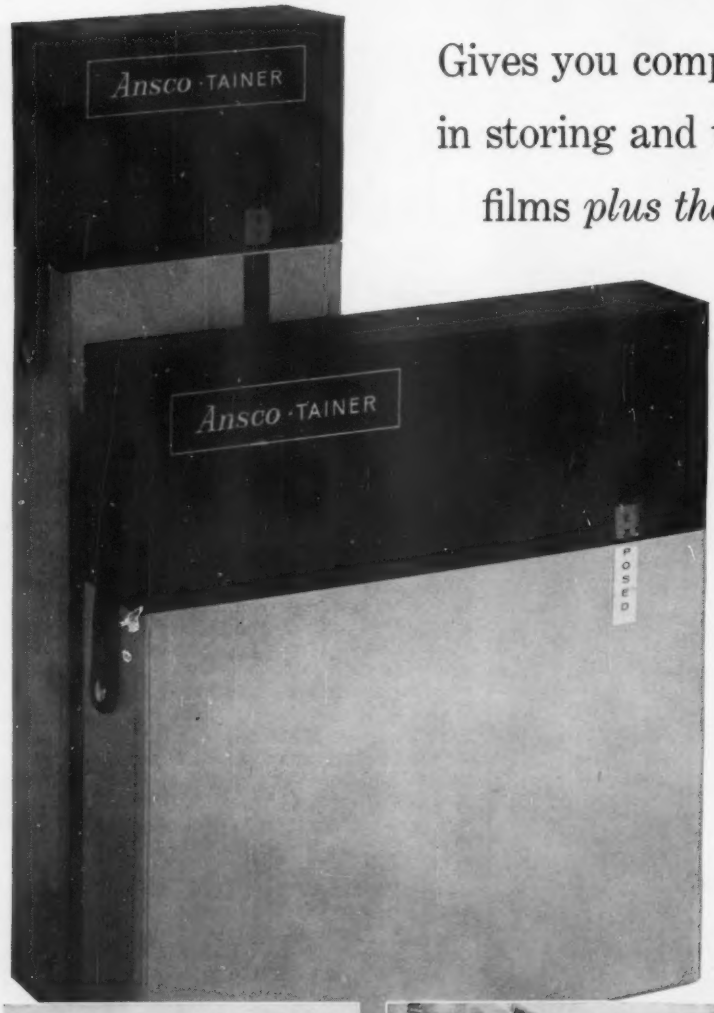

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3. Superior construction—protects film against artifacts.

4. Durable—Long-wearing plastic finish resistant to stains.

5. Perfect size—carries just the right amount of film needed to do the job . . . will hold a 75 sheet interleaved or 150 sheet non-interleaved Pouchpak from a Superpak or Bulkpak® carton.

6. Economy—costs far less than expensive suitcase containers.

7. Easier darkroom handling—cover opens and closes with ease in dark.

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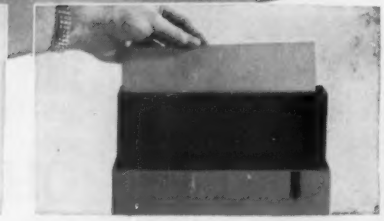
Versatile—the Ansco-Tainer is the right size for most jobs. Holds a complete Pouchpak from a Superpak or Bulkpak carton.



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Ansco

X-ray

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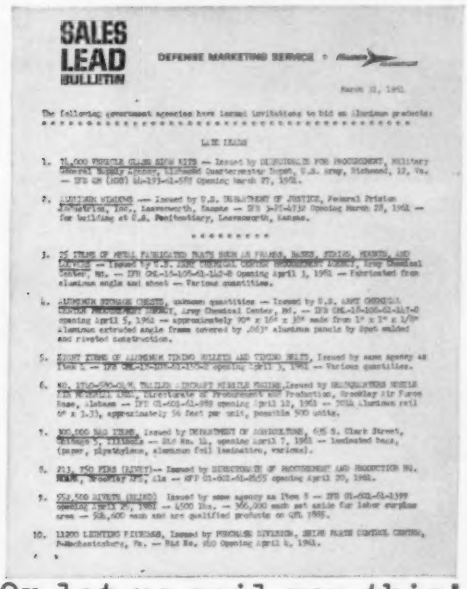

SALES LEAD BULLETIN

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March 11, 1961

The following government agencies have issued invitations to bid on aluminum products:

* *

LATE ITEMS

1. 21,000 TEXTILE CLOTH SHOW KITS — Issued by HEADQUARTERS FOR PROCUREMENT, Military Shoulder Supply Service, 1127-2nd Quartermaster Depot, U.S. Army, Richmond, 12, Va. — IFB QS (SSS) 61-193-61-591 Opening March 27, 1961.

2. LARGER WINDOWS — Issued by U.S. DEPARTMENT OF JUSTICE, Federal Prison Industries, Inc., Leavenworth, Kansas — IFB 3-25-4310 Opening March 28, 1961 — for building at U.S. Penitentiary, Leavenworth, Kansas.

* * * * * * * * *

3. 25 ITEMS OF METAL FABRICATED PARTS SUCH AS FRAMES, BASES, STUDS, MOUNTS, AND CASINGS — Issued by U.S. ARMY CHEMICAL CORPS PROCUREMENT AGENCY, Army Chemical Center, Md. — IFB CML-15-109-61-112-8 Opening April 3, 1961 — Fabricated from aluminum angle and sheet — Various quantities.

4. ALUMINUM STORAGE CRATES, unknown quantities — Issued by U.S. ARMY CHEMICAL CORPS PROCUREMENT AGENCY, Army Chemical Center, Md. — IFB CML-15-109-61-117-8 Opening April 5, 1961 — approximately 90" x 166" x 30" made from 1" x 1" x 1/8" aluminum extruded angle frame covered by .063" aluminum panels by Spot welded and riveted construction.

5. EIGHT ITEMS OF ALUMINUM TIRING BULLETS AND TIRING BELT, Issued by same agency as Item 4. — IFB CML-15-109-61-115-8 Opening April 3, 1961 — Various quantities.

6. NO. 1710-CYCLOPS TRAILER - ROCKET MISSILE TESTING-Issued by HEADQUARTERS MISSILE TEST WING (SMTW), Directorate of Procurement and Production, Brookley Air Force Base, Alabama — IFB 61-601-61-999 opening April 12, 1961 — 7075A Aluminum roll 60" x 1.33, approximately 56 feet per unit, possible 500 units.

7. 300,000 BAG ITEMS, issued by DEPARTMENT OF AGRICULTURE, 635 S. Clark Street, Chicago 5, Illinois — ITB No. 12, opening April 7, 1961 — laminated bags, (paper, polyethylene, aluminum foil lamination, various).

8. ALL 3TH ITEMS (LISTS)— Issued by DIRECTORATE OF PROCUREMENT AND PRODUCTION NO. MAAM, Brooksy AFB, Ala — RFP 01-603-61-8655 opening April 20, 1961.

9. OIL CAN SPOUTS (BRIDE) Issued by same agency as Item 8 — IFB 01-603-61-1199 opening April 27, 1961 — 4,000 lbs. — 366,000 each set axle for labor surplus area — 528,600 each and are qualified products on QPL 1985.

10. 13200 LIGHTING FIXTURES, Issued by PURCHASE DIVISION, SHIPS MAIN CONTROL CENTER, Philadelphia Navy Yard, Philadelphia, Pa. — Bid No. 910 Opening April 4, 1961.

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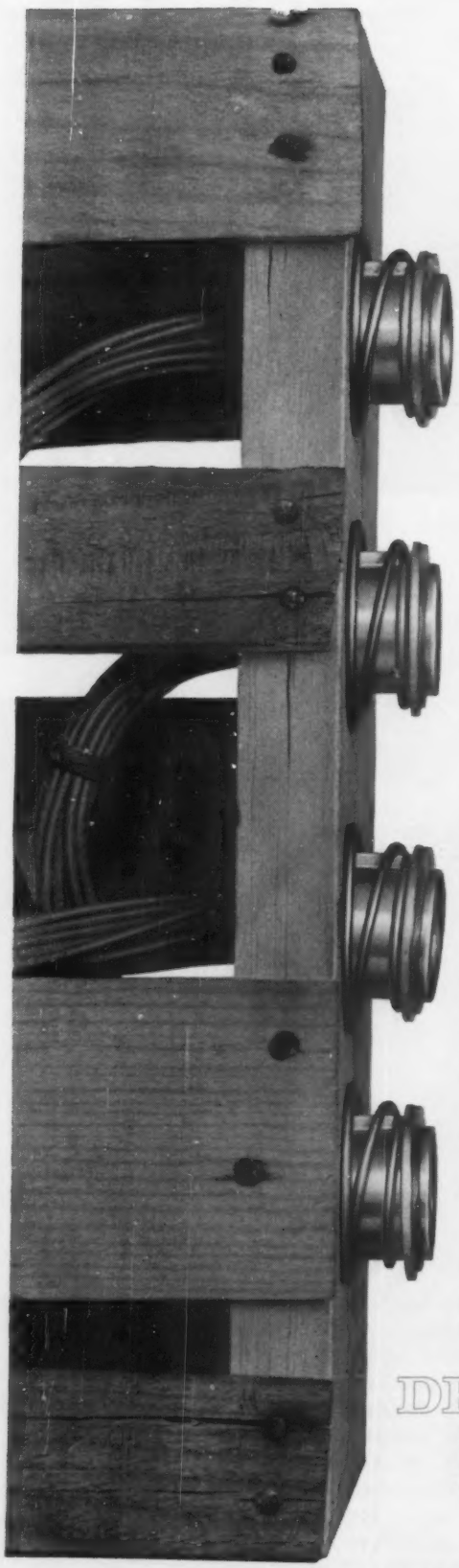

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Vegetable crate construction is generally frowned upon for complex modular installations. But, with Deutsch self-aligning rack-and-panel connectors, commercial tolerances between mounting hole centers are perfectly okay. When the drawer is slid home, each spring-mounted plug floats into engagement with its receptacle. Spring pressure then maintains an environmental seal. For complete information on this easy-to-mount line of cylindrical and rectangular rack-and-panel connectors contact your local Deutschman today or write for Data File H-5.

DEUTSCH

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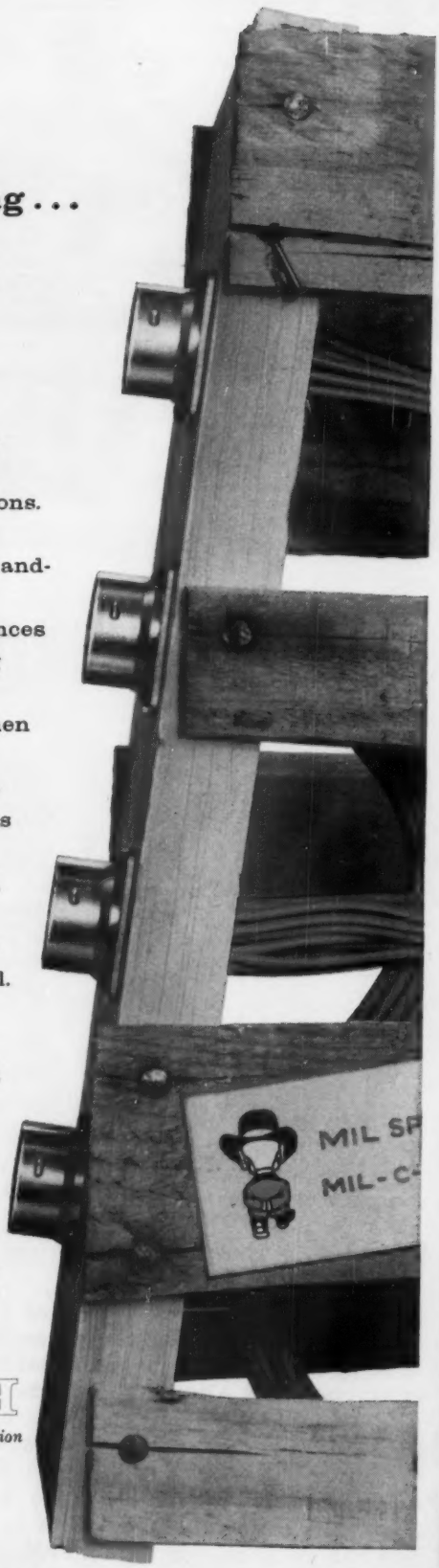
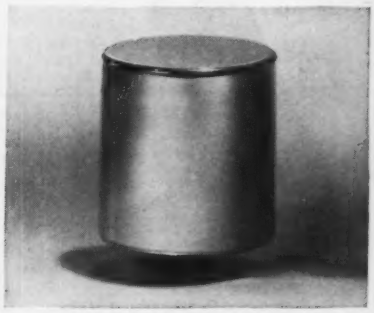


ADVANCED SPECIFICATION MINIATURE ELECTRICAL CONNECTORS

(Advertisement)

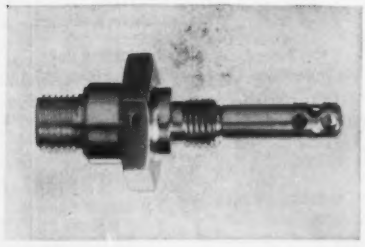
Airborne DC Amplifier



Small, solid state, direct-coupled DC amplifier weighs only six ounces. Less than five cubic inches in volume, this rugged, hermetically sealed instrument is available with solder, plug-in, coax or combination header arrangements and a variety of mountings. DC gain is 200 to 1000 ±0.75%. Input capability is 5 millivolts differential at maximum gain; output capability is ±5 volts into not less than 20K (single-ended).

Microdot Inc., 220 Pasadena Avenue, South Pasadena, California.

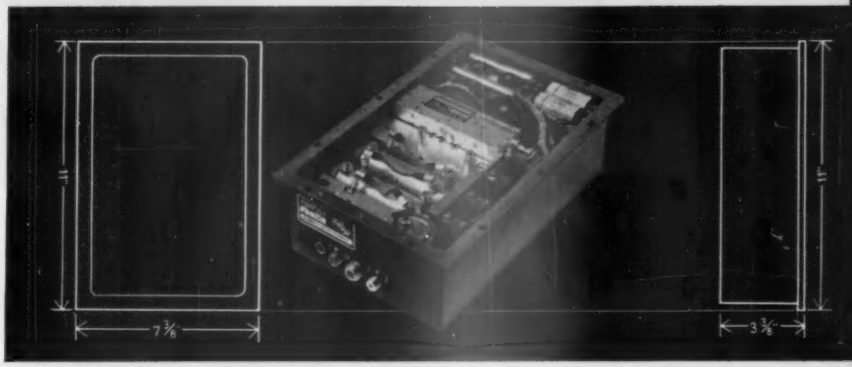
Temperature Transducer



Small probe-type device for high and low temperature applications where high pressures and severe flow conditions are imposed. Precise liquid or gaseous measurements to 800°F. Tiny sensing element of deposited platinum film allows high base resistance, extreme linearity, wide range capability, and fast response. Approved for ICBM environments.

Microdot Inc., 220 Pasadena Avenue, South Pasadena, California.

VHF-UHF TRANSMITTERS



Proved in history's most demanding environmental laboratory — outer space — the custom designed unit shown above is typical of the development skill and production capability available from Microdot. The unit shown in miniaturized, pressurized, and features a solid state power supply that cannot be damaged by input/output overloads. Units are available in a complete range of modulation — CW, FM, Phase, and Pulse, with frequency coverage 100 to 5000 mc/s and output from 100 mw to 10 watts.

Telemetry Capabilities at Microdot have been dramatically expanded with the recent acquisition of Spectralab Instrument Company. The highly regarded development skill, production capability, and working experience of Spectralab in the field of VHF and UHF cavities and related instrumentation is available from Microdot's Instrumentation Division. This equipment, outstanding in its attention to miniaturization and ruggedness, is a vital part of such important projects as Pioneer V, Jupiter, Atlas, Pershing, Redstone and Echo I.

UHF Telemetry Transmitters, Models 2406 and 2409, use a unique, automatically stabilized circuit, with the output frequency referenced directly to a quartz crystal. This approach allows a greatly reduced size compared to the multiplier chain conventionally required to achieve crystal stability, as well as increased reliability due to a fewer number of parts.

The transmitters have their own solid state power supply designed to provide a high ratio of rf output power to total power input. The frequency modulation circuitry is sufficiently linear to introduce completely negligible distortion to the modulation signal. For further information, Call Microdot or write for catalog sheet TT-1.

SPECIFICATIONS

Frequency Range:	
Model 2406	2200-2300 mc/s
Model 2409	1435-1535 mc/s
Frequency Stability:	±0.001%
Power Output:	10 watts
Power Output Stability:	1 db
Modulation:	PCM/FM, PAM/FM, FM/FM
Input Voltage:	28 vdc
Temperature Range:	−40°C to +70°C
Vibration:	10 g, 5-2000 cps
Size:	3⅜" x 7⅜" x 11"
Weight:	12 pounds

MICRODOT INC.

220 Pasadena Avenue, South Pasadena, Calif.

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▶ Transportation, fuel levy changes are key factors; airlines asking extension of temporary surcharges.

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▶ Beagle group introduces four-place A109 Airedale, Beagle-Auster two-to-three-place A61 Terrier aimed at low-cost field.

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COVER: Plug nozzle thrust chamber is fired by General Electric at its Malta Test Station near Schenectady, N. Y. Liquid oxygen and RP produced 50,000 lb. thrust at 260 psia. chamber pressure. Test was part of a program to determine feasibility of the plug nozzle concept (AW Feb. 1, 1960, p. 16). Plug nozzle thrust chamber is being developed under National Aeronautics and Space Administration contract.

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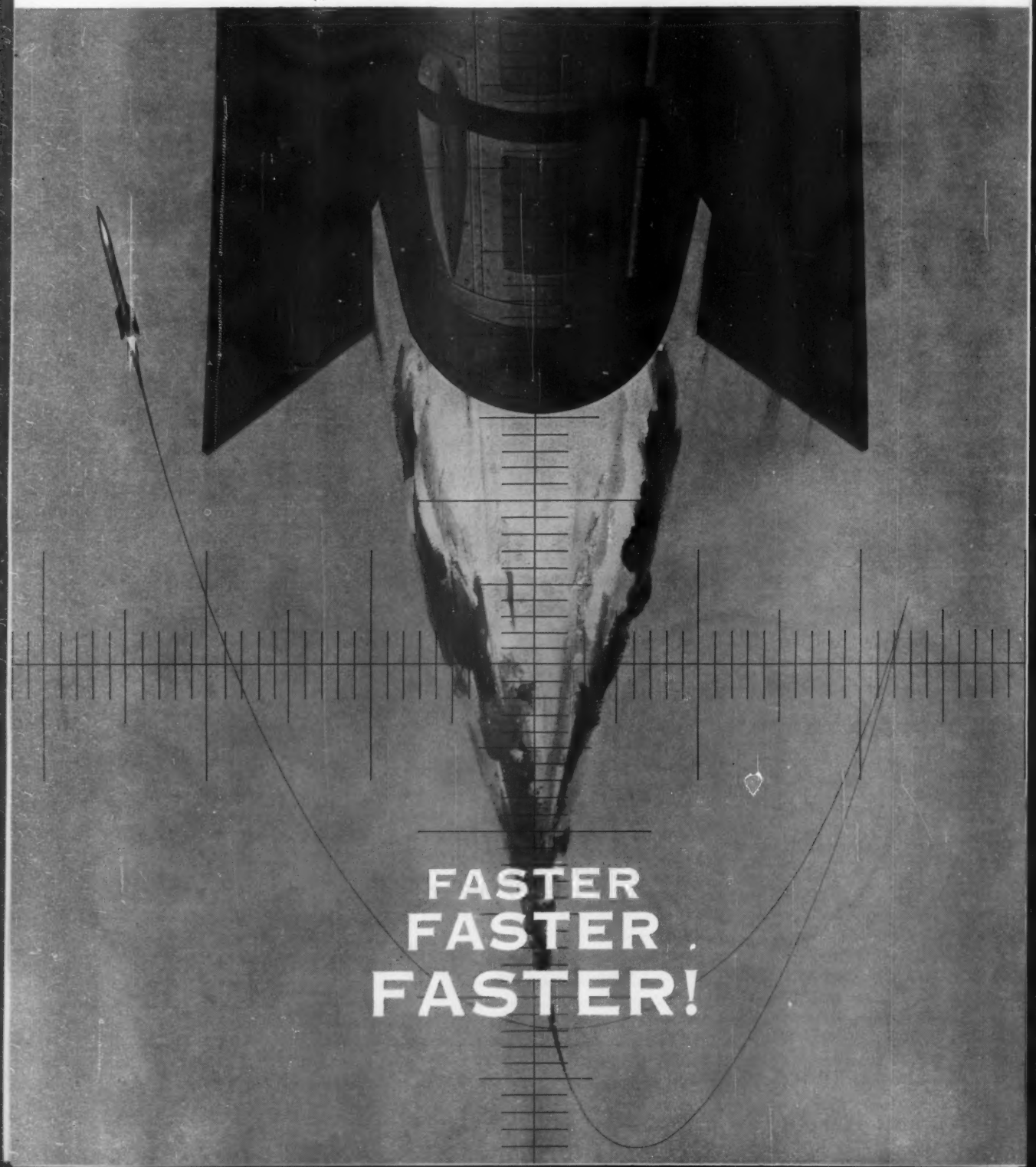

EDITORIAL

MR-3 in Perspective

Looking back on the successful voyage of Astronaut Alan Shepard in the Mercury capsule atop the Redstone booster, it is obvious that this is one of the best things that has happened to this country in many years. The MR-3 space shot must be viewed in its proper technical perspective as an early phase testing of the equipment and men who have embarked on the tremendous task of exploring space. But it must also be viewed in the proper psychological and political perspective of these troubled times.

MR-3 was a great engineering triumph with every system, subsystem, valve, relay, circuit and switch working well nigh perfectly in a fabulous sequence that matched performance with predictions so closely that in retrospect it is hard to distinguish between them.

It was also a great triumph for the astronauts who had the courage to volunteer for this necessary step in the exploration of the unknown, and the determination to stick with their chosen task despite all the early problems and disheartening experiences that are inevitably a part of any basic new exploration.

Impact on America

But more important perhaps than these aspects was the impact of MR-3 on the American people, their political leaders and on American prestige around the world.

• **First, it helped crystallize** a decision already in its formative stages within the top levels of the Kennedy Administration to get into the space race in earnest, and proclaim the goal of achieving international eminence in space as a firm national purpose. The public manifestations of this decision, reinforced in large measure by the demonstration of MR-3, will be forthcoming in the next few weeks as more money is added to both civil and military space programs and the President himself proclaims our firm national purpose to catch and surpass the Soviet Union in this vital area.

• **Second, it proved** to the rest of the world that this nation was not to be discouraged by its tardy entry into space, nor by the early successes of the Soviets. It proved that we have the vitality, technical skill and determination to stay in this race until the full course is run and that we will not quit after a few desultory laps and let the laurels pass to the Soviet Union by default.

• **Third, it provided one of the most dramatic** contrasts between the open freedom of this country and the repressive secrecy of the Soviet Union that has reverberated around the world and reflected enormous credit on our way of living. It demonstrated to billions of people all around the globe far more clearly than anything we have done in recent years just what our concept of freedom really is and how it works in our own land.

• **Fourth, it provided a badly needed sense of pride** for us at home, coming as it did after a long stretch of discouraging news going all the way back to Sputnik I. It made millions of Americans feel prideful that we are still producing pioneers such as Cdr. Shepard and his fellow astronauts, and the thousands of technicians who are supporting their effort in the design, fabrication and operation of their space exploration vehicles.

Blood, Sweat, Money

The success of MR-3, however, should not blind either the American people or their leaders to the long, hard road that lies ahead both in our own steps toward outer space and in our newly-found determination to lead the world in this endeavor. This road will be paved with spectacular failures that will extract a high price in blood, sweat and money and we shall have to pay it in the full glare of worldwide publicity without wavering in our purpose to achieve the ultimate and inevitable success we seek.

Despite the success of MR-3, we are still in a long stern chase with the Soviets in space. It is evident from the details of the Soviet's Vostok space ship that they have considerable lead not only in the field of boosters big enough to hurl heavy payloads into orbit but also in the bioastronautics systems required for long space voyages. This vital area of bioastronautics is another case where the full technical resources already available in this country have not yet been properly marshaled nor addressed to the space tasks ahead.

Spectacular Proof

The initial space voyages of Maj. Gagarin and Cdr. Shepard have proved in spectacular fashion that man not only can survive in space but can work under the conditions imposed by spaceflight. These performances should permanently rout the scientific conservatives who have consistently scorned the possibility of man functioning usefully in space and have tried, almost too successfully, to label as wasteful folly the Mercury man-in-space program and its proposed follow-ons such as Apollo.

We must be reconciled to the Soviets making longer and more complicated manned space voyages than our Mercury program can ever produce, but we must not lose this new-found determination to pursue the space race with all of the technical resources at our disposal as a basic national purpose. For not only will our achievements in this area serve as an international demonstration of our vitality, skill and determination but they will produce an enormous technical fall-out that will flower into basic improvements in the life of mankind all over this tiny planet.

—Robert Hotz

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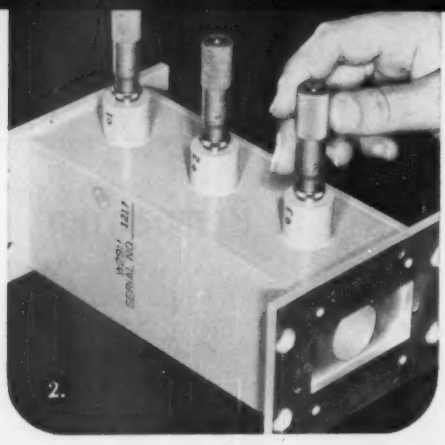
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TI's RADAR CAPABILITY...

4.

For systems requirements, Texas Instruments now offers major advancements in microwave techniques resulting from 15 years' experience in the development and production of radar equipment. Significant technological advancements include receiver front-end improvement through the following...

1. Broadband parametric amplifiers — typical improvement in radar system noise figures possible with these devices ranges from 4 to 6 db. For comparable range improvement, using conventional techniques, it would be necessary to double antenna size or quadruple transmitter power.

2. Pre-selector filters — screen out interference from other radars.

3. Solid-state microwave sources — used as local oscillators or parametric amplifier pump sources... these devices are crystal-controlled for high stability and can be used in any application requiring a stable, reliable signal source.

Examples of TI radar systems operational today include the following...

4. Surveillance sensors for the U. S. Army Signal Corps AN/USD-5 combat drone, produced by Fairchild.

5. AN/APQ-86 reconnaissance radar in the U. S. Army Signal Corps L-23 aircraft.

6. AN/APS-80 radar and APA-125A indicator in U. S. Navy P3V ASW patrol aircraft.

7. Engagement displays for Nike-Zeus — the U. S. Army's anti-ICBM defense system, produced by Western Electric Company.

8. ASR-4 radar for Federal Aviation Agency controls airport traffic in congested areas. Display console gives clear indication of moving targets.

9. ASR-4 equipment cabinets typify system's design — all components uncover for easy servicing.

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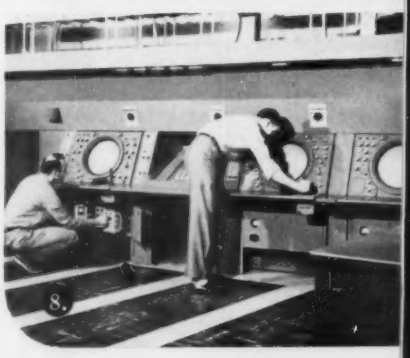
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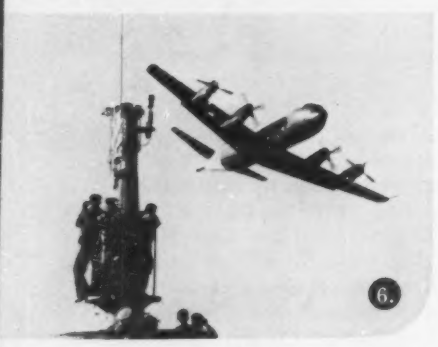
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WHO'S WHERE

In the Front Office

Dr. S. Fred Singer, a director, the Decker Corp., Bala Cynwyd, Pa. Dr. Singer is professor of physics, University of Maryland.

Harry Fante, president, Aero Commander, Inc., Bethany, Okla. Mr. Fante is executive vice president of Rockwell-Standard Corp., the parent company.

J. J. Flaherty, executive vice president, Atomics International, a division of North American Aviation, Inc., Canoga Park, Calif. Also: **W. L. Sequeira,** vice president-planning; **Dr. W. E. Parkins,** assistant to the president-technical planning. Atomics International has formed six new divisions and made the following appointments: Compact Systems—**Dr. A. B. Martin,** vice president and manager, and **Ralph Balent,** associate manager; Power Systems—**Dr. Sidney Siegel,** vice president and manager; Research—**Dr. H. P. Reiss,** director; General Development—**Dr. Harry Pearlman,** manager; Administration—**W. L. Sequeira,** acting manager; General Services—**R. K. Holbrook,** manager.

Hans Weichsel, Jr., vice president-military contracts, Bell Helicopter Co., Ft. Worth.

G. W. Rutherford, vice president-operations, Ryan Aeronautical Co., San Diego, Calif., and **H. L. Fontaine,** vice president-manufacturing.

Thomas Allinson, vice president-corporate planning, Daystrom, Inc., Murray Hill, N. J.

David H. Baker, a vice president of Vickers, Inc., Detroit, Mich., and general manager of the company's International Division. Mr. Baker, former president of Capital Airlines, succeeds **R. E. Esch,** retiring.

Honors and Elections

Lee S. Johnson, general manager of the Sikorsky Aircraft Division of United Aircraft Corp., has been elected board chairman of the American Helicopter Society for 1961-62, and **Brig. Gen. Clifton F. von Kann,** director of U. S. Army Aviation, was elected president. Named as regional vice presidents: New England—**Bruce A. Goodale,** Kaman Aircraft Corp.; Mideast—**James D. McFarland,** Vertol Division of the Boeing Co.; Southeast—**W. G. Rhodes,** Cessna Aircraft Co., Washington, D. C.; Midwest—**Richard A. Dean,** McDonnell Aircraft Corp.; Southwest—**Wesley L. Cresap,** Bell Helicopter Corp.; Western—**Robert A. Wagner,** Aircraft Division of Hughes Tool.

American Helicopter Society Awards were presented to: **Link Luckett,** helicopter charter operator who rescued two stranded mountain climbers from Mt. McKinley, Alaska, flying a Hiller 12E aircraft—the Carnegie Award for Heroism and the Frederick L. Feinberg Award; **Army's 56th and 57th Medical Platoons (Air Ambulance)**—the Capt. William J. Kossler Award for their Operation Amigo during the earthquake emergency in Chile last summer; **Leon L. Douglas,** director of engineering for Vertol Division of Boeing—the Dr. Alexander Klemin Award for "notable achievement in the advancement of rotary wing aeronautics."

(*Continued on page 135*)

INDUSTRY OBSERVER

► Air Force has a scientific payload piggyback program scheduled for 22 Atlas flights, with the first shot planned this week from Cape Canaveral using an Atlas E. Atlas F probably will be used late in the series. Piggyback payloads, none carrying live subjects, will be allotted to industry, universities and other government agencies. Martin and Air Force Special Weapons Center have instruments in the first payload.

► **System requirements for a second generation Nike Zeus anti-ICBM system, to be called Zemar, are under study by Army Ordnance Corps.**

► Lockheed is studying an Agena C upper stage rocket that could be used, presumably with the Atlas booster, to put 2,200 lb. into a 3,500-mi. orbit or 1,000 lb. in a 22,300-mi. orbit. Agena C would have twice the capability of Agena B, probably achieved by doubling the Agena B's tank volume. No development has been funded.

► **Canadian navy is considering the turbine-powered Kaman HU2K utility helicopter as an anti-submarine warfare aircraft, using an ASW package with greater detection range than the AQS-12 equipment the U. S. Navy will try with the HU2K. The helicopter would operate from a platform on the stern of a Canadian destroyer escort. Tests with other helicopters have convinced Canada they can be used in the North Atlantic with 50-ft. ceiling, 50-ft. visibility conditions.**

► Pratt & Whitney has successfully fired the LR-115 oxygen-hydrogen engine 75 times since test stands were repaired after two explosions (AW Apr. 24, p. 27). Two primary engine changes are an increase in the injector exhaust flow rate and installation of an abort sensor. Sensor is a wire in the exhaust stream which must burn through within a specific period or the engine is shut down.

► **Six-pound monkey, fitted with implanted biosensor telemetry equipment, is scheduled to be launched in July on an Atlas E ballistic flight from Cape Canaveral. It will be carried piggyback in a recoverable pod. North American Aviation is program manager for the Air Force Systems Command experiment, and Space Labs, Inc. developed the telemetry system.**

► NASA's second nuclear emulsion recovery vehicle is scheduled to be launched from Pt. Arguello, Calif., in October, using Aerolab Development's Argo D-8 booster. Four Nerv shots were planned originally, but two Argo D-8 vehicles were diverted to the agency's Wallops Station for other tests.

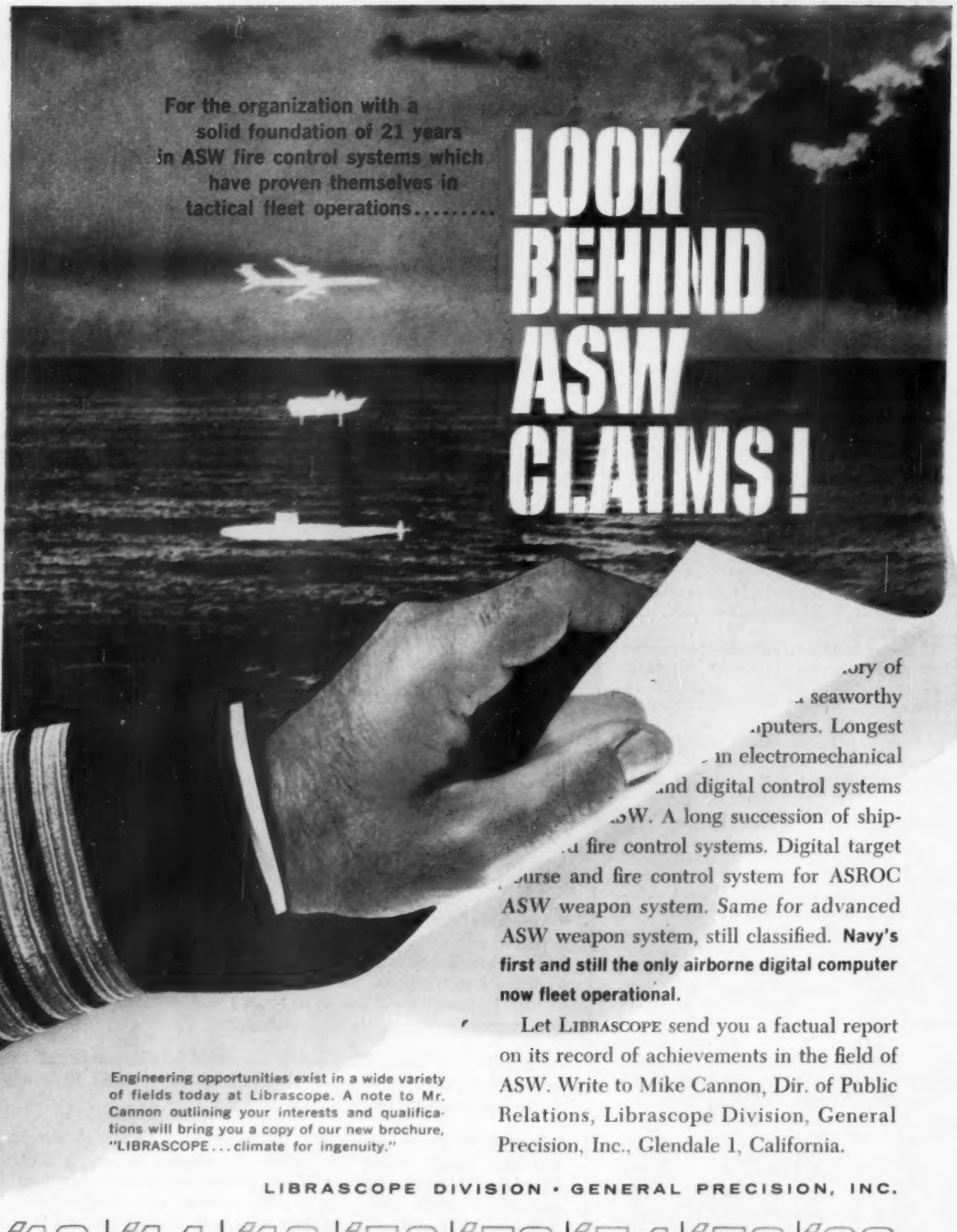
► **American Machine & Foundry's Greenwich, Conn., Engineering Division is performing architect and engineering services for redesign of launch pad 20 at Cape Canaveral, Fla., to handle the Boeing Dyna-Soar boost glider. Modifications to the pad, which now launches the Martin Titan I and will be used to launch the Titan II to boost Dyna-Soar, may require a new gantry at a cost of approximately $2.5 million.**

► Proposals will be submitted July 10 under field Army ballistic missile defense system feasibility studies which six industry teams are conducting for Army Rocket and Guided Missile Agency.

► **Pratt & Whitney proposed a feasibility study of a high pressure oxygen-hydrogen rocket engine last month in response to an Air Force Systems Command request which followed several unsolicited proposals to NASA and USAF (AW Mar. 20, p. 50). Advantage cited for the engine is that it would enable a single stage vehicle to boost a payload into a 300-mi. orbit.**

► Next Midas early warning satellite development shot will carry some equipment not tested in earlier flights and will be launched by a modified and improved Convair Atlas.

► **Northrop Norair Division has proposed development of an adapter to provide limited maneuverability for National Aeronautics and Space Administration's Mercury manned space capsule. Proposal stemmed from a company-funded feasibility study.**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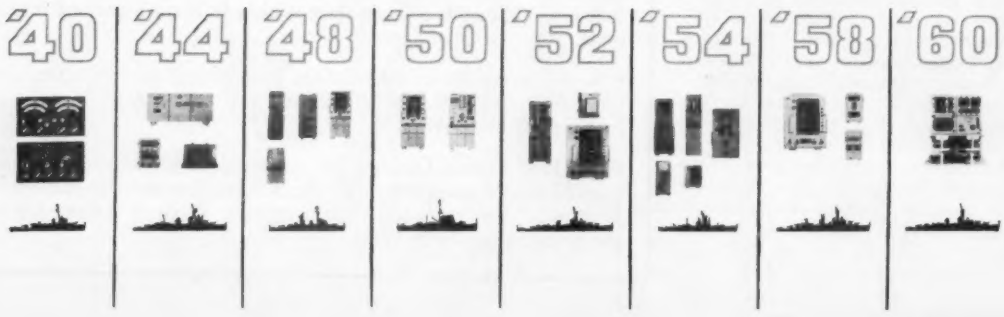


Washington Roundup

Space Scrutiny

President Kennedy's request for more space funds (see p. 26) will set off reviews in Congress of the administrative machinery in the two agencies that will spend the extra money—National Aeronautics and Space Administration and elements of Defense Department. The House Science and Astronautics Committee is expected to be the first to conduct such a review—probably a week after the President submits his money request.

Dispute between the Air Force and the Navy on whether the U. S. should work toward land or sea missile launching bases also is expected to surface in House space committee hearings. USAF would like land bases in equatorial countries so the courses of missiles do not have to be changed on the way to some targets. Navy contends that launching from ships or from sea platforms makes more sense. The committee will try to bring the argument into focus at hearings on equatorial launch sites, set for this week.

An eagerly-awaited expression of the government's anti-trust policy on commercial communications satellites has been made by the Justice Department. It advised the Federal Communications Commission last week that it believes such a system should not be owned or controlled by a single private organization, regardless of the extent to which the organization might be subject to government regulation.

Justice said all interested common carriers should have an opportunity to participate in system ownership and to have unrestricted, non-discriminatory use of such a system. Aerospace producers of communications satellites also should be given a chance to participate in ownership, but this should not be a requirement for them to bid on satellite contracts.

Goldberg's Tightrope

Labor Secretary Arthur J. Goldberg is walking a tightrope in his effort to achieve labor peace at missile bases (see p. 26). On one side of him are Sen. John McClellan and others in Congress who are ready to press for anti-strike legislation. On the other are labor chiefs who supported President Kennedy's campaign and charge that McClellan's hearings have been unfair to them.

Goldberg, who has been successful in similar missions, is holding daily meetings trying to persuade all parties that the President just wants an equitable agreement to keep the missile program moving swiftly. Likely results are pledges by labor to go all-out to settle disputes without strikes, and appointment by the President of a citizen panel to take over when regular collective bargaining negotiations break down.

Atomic energy program has such a panel, headed by former Federal Mediator Cyrus Ching—one of the men Goldberg is consulting. The Ching panel makes recommendations for settlement after regular efforts fail. This exerts public pressure on the disputing parties.

Goldberg will oppose no-strike legislation. He feels strikes are a legitimate economic weapon at defense plants as well as elsewhere.

Defense Secretary Robert McNamara, who has been a popular witness on Capitol Hill, has had his first rebuff from Congress. When he learned that armed services committees intended to put money for manned bombers into the budget, he made a special trip to the Hill to protest, but had no luck. One committee added $337 million, the other added $525 million (see p. 27).

Information Flow

A freer flow of information from the government won two skirmishes last week, in spite of early indications that the President might limit the flow and continued evidence that Secretary McNamara feels the U. S. gives away far too much data (see p. 39).

President Kennedy met with editors and publishers to discuss his earlier request for "restraint" and some voluntary censorship from the press, and apparently reversed his former stand, indicating there is no need for action at this time.

He also reiterated remarks made at a press conference after Astronaut Alan Shepard's successful flight that put the U. S. firmly in the position of keeping its space shots open to public view in spite of the bad propaganda effect that failure could bring.

Shortly before Shepard's flight, a number of the President's top political and scientific advisers exerted extreme pressure on him to postpone the shot until the U. S. position in international politics was stronger, or at least to close the shot to the press. Others risked their careers to fight this point of view, and the gamblers—including President Kennedy—won handsomely.

Two offices under the Air Force deputy chief of staff for plans and programs are being disbanded after coming under Administration fire for opposing proposed defense policy changes. Brig. Gen. Noel F. Parrish, assistant to the director for plans, will become director of the Research Activities Institute of the Air University and Brig. Gen. Robert C. Richardson will become deputy director of the Military Assistance Division, U. S. European Command in Paris. —Washington Staff

Kennedy to Launch Major Space Effort

New budget request, expected to total $600 million, seen as beginning of attempt to outdistance Soviets.

By George C. Wilson

Washington—President Kennedy has made a firm, basic decision to launch an all-out effort to put the U. S. ahead of Russia in the space race. He will delineate his reasoning soon in a major policy statement and follow it with a detailed request to Congress for more money—probably as much as $600 million, with $500 million going to the National Aeronautics and Space Administration.

This decision, reached gradually by the President during his first three months in office, rejects the conservative viewpoint within the Administration that spending money to send men to the moon and to the planets amounts to stunting, not solid scientific achievement.

This conservative view was held by President Eisenhower and is shared now by some officials within President Kennedy's Administration, including some scientific advisers and some NASA scientists.

Decision to ask for an increase of approximately 25% in the combined Fiscal 1962 civilian-military space requests of $2.4 billion resulted from a review of the space effort ordered by President Kennedy three weeks ago, following reversals for the U. S. in space coupled with trouble in Cuba and Laos.

Crash Review

The review was conducted on a crash basis, shortcutting the usual channels for developing a budget increase. The review involved the Vice President, Presidential Science Adviser Jerome B. Wiesner, the National Aeronautics and Space Council, NASA, Defense Department, Budget Bureau and other agencies.

The plan to give NASA $500 million and the Defense Department $100 million will be contested privately, and perhaps publicly, by the military services, which contend it is time to admit that U. S. survival may depend on military space vehicles. They fear letting NASA and the military follow separate paths in space development will leave dangerous gaps, and that the present program is only a start toward the effort needed.

So far, the Kennedy Administration has followed former President Eisenhower's lead in portraying its space program as primarily a peaceful, scientific endeavor.

The President's decision to accelerate the space effort parallels these other activities in the executive branch and in Congress aimed at giving the U. S. space and defense programs more vitality:

• **Labor Secretary Arthur J. Goldberg** opened a series of high-level meetings last week with government, labor and management officials preparatory to recommending presidential action to prevent further work stoppages at missile bases.

• **House Science and Astronautics** Committee prodded the Kennedy Administration to move faster on nuclear rocketry, expressed dismay that NASA was delaying a private program that promised to put the first communications satellite in orbit, and authorized more money for NASA than the President had asked.

• **Chairman of the Joint Congressional** Research and Development Subcommittee on atomic energy said he would hold hearings to find out why the Administration canceled the Aircraft Nuclear Propulsion program.

J85 Lift-Fan Testbed

North American Aviation's Columbus Division has proposed a modification of its T2J-1 Buckeye jet trainer as a testbed vehicle to flight-test the General Electric J85 lift-fan VTOL concept. NAA proposal is in response to U. S. Army Trecom requests for proposals from industry to supply two airframes in the 5,000-8,000-lb. weight class that would be fitted with the GE lift-fan concept for flight test follow-on of some three years of ground testing of the powerplant and VTOL system.

Approximately 18 airframe manufacturers have been invited to participate in the program—it is expected that at least six or seven will submit specific programs involving modification of existing airframes in this weight class to fit the GE J85 VTOL concept. Indications are that the program could run some $3-$4 million. Trecom is expected to announce awards of airframe modification programs in July.

President Kennedy soon will use the powers of his office in an attempt to achieve the type of labor-management harmony needed to keep the missile program moving as rapidly as possible.

Chairman John L. McClellan (D.-Ark.) of the Senate Permanent Investigations Subcommittee triggered this presidential interest by holding hearings which showed that the U. S. lost more than 400 man-years of labor (162,872 man-days) at missile bases because of 327 work stoppages since 1956. Most of the trouble occurred at the Air Force Missile Test Center in Florida and at Vandenberg AFB, Calif.

Reasons for Delays

Witnesses blamed the Air Force, contractors, labor unions and Labor Department for the delays and stoppages. Committee investigators detailed unusually high wages at the missile centers, including weekly pay for electricians at Vandenberg ranging from $413 to $670. The unions, according to testimony, insisted on working shifts that provided a maximum of overtime even when this was not necessary.

Sen. McClellan lost his temper frequently through the hearings, declaring, "I would do anything to bring about expedition of this program because I think our destiny may depend on it. I really do." He repeatedly asked witnesses for suggestions for remedial legislation.

Last week the Administration stepped into the picture. Secretary of Labor Arthur J. Goldberg said the missile program was of "the utmost urgency" and needed harmonious labor-management relations.

Goldberg announced a series of meetings with labor, management and conciliation leaders on the stoppages at missile centers. He said that after the meetings, scheduled to end early this week, he would make recommendations "promptly" to President Kennedy for "executive action to get uninterrupted work on the missile program."

Goldberg declined to speculate on what form this executive action might take or whether it would obviate the need for the legislation Sen. McClellan is considering. But McClellan himself displayed a wait-and-see attitude by calling off the subcommittee hearing scheduled for the middle of last week, declaring that he did not wish to interfere with Goldberg's negotiations.

The Defense Department also is reviewing its contracting procedures. Goldberg and Secretary of Defense Robert S. McNamara discussed the missile labor troubles last week.

Rep. Melvin Price (D.-Ill.), chair-

man of the Research and Development Subcommittee of the Joint Atomic Energy Committee, told AVIATION WEEK he will ask Administration officials in special hearings this month or next to explain why they halted the Aircraft Nuclear Propulsion program. Price recently took issue with Secretary McNamara's decision to cancel the ANP effort, and is readying a speech to detail the military advantages of a nuclear airplane.

The House space committee in its report on the Rover nuclear rocket project said: "The development of a nuclear rocket is an essential step" in getting adequate propulsion systems. "The success of Project Rover will determine whether or not the U.S. will have a meaningful manned space exploration program."

Rover Speedup Urged

The committee called for "basic policy decisions" on the degree of future emphasis to place on chemical and nuclear rockets and recommended accelerating Project Rover by assigning it the highest national priority.

In hearings early last week, the space committee heard officers of several companies describe their plans for a worldwide communication system in which signals would be bounced off satellites (AW May 8, p. 34).

Chairman Overton Brooks (D.-La.) said the communications satellite system held great commercial promise. Rep. Joseph E. Karth (D.-Minn.) urged the interested industries to get together on one system so the government itself would not have to dictate one.

James E. Dingman, vice president and chief engineer of American Telephone and Telegraph Co., declared his company could launch an experimental communications satellite this December if NASA would supply the Thor booster.

Dingman said the company requested the booster formally last Dec. 14, but has heard nothing since from NASA. AT&T would pay for the booster and launching costs, he said. Rep. James G. Fulton (R.-Pa.) denounced the delay, and said: "We certainly need some more management in NASA." The committee is expected to prod NASA for an early decision.

The committee's effort to develop what Rep. Brooks calls "a sense of urgency" about the space program also showed itself in the Fiscal 1962 NASA authorization bill, which the committee sent to the House floor early last week. The committee authorized $1,376,900,000, or $126,600,000 more than President Kennedy requested. The major increases were for the Apollo three-man space vehicle, Rover and solid-propulsion programs (AW May 8, p. 27).

Senate Group Joins Bomber Drive, Adding $525 Million to Budget

By Katherine Johnsen

Washington—Drive in Congress—with widespread support and apparently no opposition—to continue the Boeing B-52, armed with Skybolt missiles, as the bomber backbone of Strategic Air Command into the 1970s was highlighted last week when the Senate Armed Services Committee unanimously added $525 million for "procurement of manned, long-range aircraft" to the President's Fiscal 1962 program.

House Armed Services Committee previously approved, also unanimously, $337 million for the purchase of manned bombers which are now in production for SAC (AW May 8 p. 26). Next step is action by the full House and Senate on the separate proposals of their committees.

The actions were taken following extensive closed-door sessions marked by congressional and Defense Department skepticism on the capabilities of missiles, the B-70 Mach 3 bomber Air Force has urged as a successor to the B-52, and the Convair B-58, SAC's new supersonic medium bomber.

Both committees, writing their authorizations for Fiscal 1962 aircraft and missile procurement, left the selection between B-52 and B-58 to Air Force and Department of Defense.

Secretary of Defense Robert S. McNamara and Air Force Chief of Staff Thomas D. White, however, made it unequivocally clear that their choice would be the B-52 in the executive testimony, released last week by Senate Armed Services Committee.

Skybolt Advantage

The fact that the B-52 is designed for Skybolt, enabling it to hit from many unpredictable directions at long distances from enemy targets, weighed strongly in its favor. Neither the B-70 nor the B-58 is designed to launch Skybolt. Gen. White said that Air Force has received manufacturers' studies for B-58 reconfiguration to adapt it to the missile, but that USAF is viewing these "skeptically."

Skybolt will go into the inventory in 1965 and have an estimated four to five-year life. B-52 life is estimated at eight years, and continued production is necessary to accommodate Skybolts into the 1970s.

Gen. White expressed confidence in the eight-year life, but confirmed that the G and H models "are the ones that are in the biggest trouble." Lt. Gen. Mark Bradley, deputy chief of staff for materiel, confirmed AVIATION WEEK's report (AW Feb. 20, p. 35) that there is "a terrific stress on the wing skin" in the later models, which carry fuel in the wings. "We are having trouble with the Gs and we predict trouble with the Hs, and it looks like we will probably have a major modification program to keep them flying," he said.

Neither the Eisenhower nor Kennedy Administration defense budgets for Fiscal 1962 included funds for either B-52s or B-58s. This would mean that production lines for both types would cease in mid-1962.

B-52 Wing Requested

Air Force has requested additional Fiscal 1961 financing, plus $230 million for Fiscal 1962, to buy an additional B-52H wing.

The $525 million approved by Senate Armed Services would purchase the one wing.

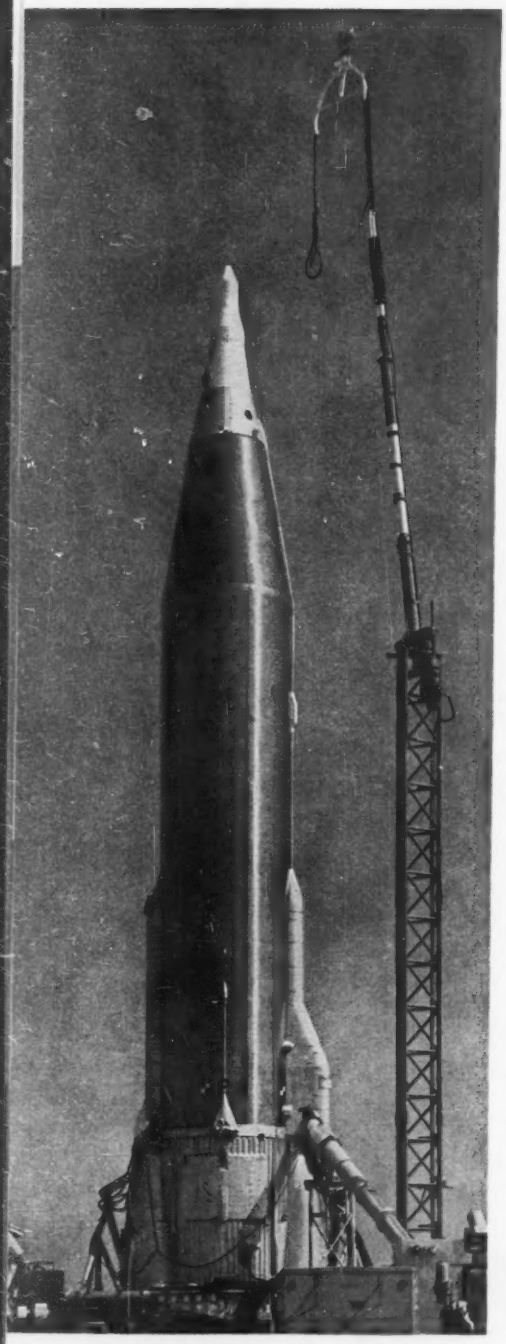
At the congressional sessions, McNamara viewed USAF's B-52 proposal as being temporarily shelved for later re-consideration—rather than flatly rejected.

If missiles were not as effective as we thought they might be, he observed, "we have a potential insurance program in the B-52." McNamara pointed out, however, that if production were once stopped—as it will be if funds are not included in the Fiscal 1962 budget—the cost of re-starting it would be in the neighborhood of $300 million, and there would be a lapse of approximately two years before deliveries would start.

"But we do have the opportunity to resume the B-52 production at a later date should that appear desirable," he emphasized. Asked by Sen. John Stennis (D.-Miss.) "if you should go back into the known bombers—those that are in existence—you would be going to the B-52 rather than the B-58," McNamara said "that is correct."

McNamara was adamant against any acceleration of the B-70 program. He stated that he believes the program will be dropped after the development phase, and an alternative manned weapon system selected as a follow-on to the B-52. He said "the program and its management needs a complete review."

This indicates that even if Congress were to authorize and appropriate additional B-70 funds—now highly unlikely—they would be impounded by the Administration. The $575 million requested for Fiscal 1962 by Air Force for B-70 was reduced to $338 million by the Eisenhower budget and to $220



Mk. 5 Nose Cone on Atlas

Avco Mk. 5 nose cone, designed for the Minuteman, sits atop a Convair Atlas E-series missile at Cape Canaveral, Fla. Novel combination of the two is due to USAF reentry vehicle program office's requirement that all nose cones be adaptable and interchangeable on any ICBM. Also, USAF foresaw early completion of testing of Mk. 3 and 4 vehicles and, since Atlas is still undergoing flight testing, decided to fly some Mk. 5 units aboard the liquid-fueled ICBM. E-series is equipped with Arma all-inertial guidance.

million by the Kennedy budget.

Asked by Sen. Clair Engle (D.-Calif.) whether the B-70 should be developed and tested as a weapon system at the earliest possible time, McNamara responded:

"I definitely do not. I definitely do not. I don't want any misunderstanding on this point. I think it would be a serious waste of this nation's resources to pursue that program."

McNamara reported that studies are under way on manned aircraft systems to fill two roles which B-70 is unsuited for.

These are:

• **"A long-endurance aircraft** which could maintain an air alert status, in a sense a cruising position, from which they could launch air-to-ground missiles." A major objective of the system, McNamara said, would be to avert as far as possible, the high vulnerability of bombers on the ground in a missile era.

• **A strategic system for economic** delivery of conventional weapons. This system would look to a possible era of nuclear weapon control or deterrent balance. B-70 would be even more uneconomic than missiles for delivery of conventional fire-power, McNamara said, commenting that B-70 "would be so expensive per unit of non-nuclear destruction as to be absolutely unworthy of procurement."

White Supports B-70

Later, Gen. White challenged this, stating: "Greater weight than any other vehicle could be carried by the B-70 and it is true that if the nuclear weapon is ruled out, this would be one of the most valuable items I can conceive of for the delivery of conventional weapons."

McNamara said consideration has been given to using B-70 as a recoverable first stage for an orbital launch —and specifically as a first stage boost for Dyna-Soar—but it was rejected as "not practicable."

Aside from some advancements in general technology, McNamara discounted the possibility of a commercial adaptation of B-70. Gen. White concurred in this position. "We have discussed this matter with the civilian aviation authorities, and it does not have commercial possibilities," McNamara said.

Adm. Arleigh Burke, chief of naval operations, supported McNamara's position on the B-70: "I do not see that it has enough advantages over the B-52 to warrant the expenditure because it does not gain enough. It is just as vulnerable, nearly as vulnerable, to a surface-to-air missile."

McNamara and Gen. White did agree that the B-58 is a valuable SAC element—but they do not want to purchase any more of the aircraft.

Air Force asked for no B-58 funds in its Fiscal 1962 budget proposals, nor did it include the B-58 in its list of "essential" programs that could not be financed within its budget ceiling.

Explaining his definite preference for continuation of B-52 production, rather than the B-58, Gen. White observed.

"The B-58 does not have as much range as we would like it to have, and it does not carry a multiple bomb load. It carries one weapon in a pod. Now that one weapon is a big weapon and it can go in at very high speeds and with refueling it can reach many targets. But adding it all up, it was a fairly expensive weapon system for the effectiveness that it could achieve in comparison with other weapon systems." Cost of the B-58, USAF reported, has dropped from $25 million each for the initial aircraft, to $17 million each in Fiscal 1960, and to $11 million each in the final Fiscal 1961 purchase. Current B-52 cost is $8.7 million each.

Missile Cost

McNamara reported these missile unit costs: Minuteman in silo, $3.2 million; mobile Minuteman, $5 million; Polaris, $9.7 million.

The $525 million for SAC bombers was the only change made by Senate Armed Services in the Administration's aircraft and missile procurement program for Fiscal 1962 (AW Apr. 3 p. 26). The committee voted down $169 million proposed by Sen. Strom Thurmond (D.-S. C.) to move Army's Nike Zeus anti-missile missile into production. McNamara indicated that $8.5 billion is an optimistic estimate of the cost for effective deployment of Nike Zeus.

Midas in Doubt

While endorsing $60 million more than the $147 million recommended in the Eisenhower budget for Midas, aimed at cutting the 15-min. warning of missile attack by Ballistic Missile Early Warning System in half, McNamara was skeptical of the outcome of the Midas program:

"There are a number of highly technical, highly complex problems associated with this system. The problems have not been solved, and we are not prepared to state when, if ever, it will be operational."

In addition to $337 million for bombers, House Armed Services added these three items to the President's program, which next goes to the House floor for action: $21.5 million for turbofan engines for Military Air Transport C-135 cargo aircraft; $25 million for three long-range jet executive aircraft, and $10 million for nuclear-powered guided missile frigates.

Atlas Tests Key to Manned Orbital Flight

By Edward H. Kolcum

Washington—Success of the first manned Project Mercury ballistic flight shifts the burden for the next major U. S. space milestone—manned orbital flight—directly to the performance of the Atlas launch vehicle in two development tests considered essential before man can be sent into orbit.

Although the success of the Redstone ballistic flight may permit reduction of the suborbital program to only two more manned missions, timing of manned orbital flight is keyed directly to the engineering confidence which must be developed from Mercury-Atlas 4 (MA-4), a single orbit flight without a passenger, and MA-5, a three-orbit mission carrying a chimpanzee.

Introduction of Cdr. Alan B. Shepard, Jr. into the Mercury-Redstone 3 (MR-3) capsule system as an engineering test pilot and scientific observer resulted in a wealth of technical data which is not expected to differ appreciably from predicted performance (see p. 31).

Non-Technical Impact

Degree of the non-technical impact, however, could not be predicted before the May 5 mission, and it continues to be reflected in:

- **National pride,** politically and scientifically. Shepard's flight brought the first major boost in morale since Sputnik I in 1957 and came at a time when White House leadership was under extreme pressure after the Cuban and Laotian political setbacks.
- **World prestige,** which came from the completely open manner in which the launch and recovery were conducted. James E. Webb, National Aeronautics and Space Administration chief, took a propaganda gamble on the success of the flight by joining the advocates of an open shot. He prevailed against the wishes of several top presidential advisers, who were not as confident of success. Nearly 100 foreign correspondents were accredited to cover the launch with about 400 U. S. newsmen. Few foreign papers fail to contrast the Shepard flight with the secrecy surrounding the orbital mission of Soviet Maj. Yuri Gagarin.
- **Confidence in the national** scientific capability, damaged by the series of dramatic Soviet space shots, has been largely restored. NASA's leadership in the space effort, which it has been forced to defend continually since it came into existence in 1958, has been reinforced to the point where its programs apparently will be funded fully (see p. 26).
- **Support for an integrated** national space effort, which was lukewarm before the manned ballistic shot. A solid success like MR-3 was useful in illustrating that a NASA-Defense-industry team is mutually essential for Mercury and other space projects.

Although NASA officials consistently caution that the Mercury-Redstone flight should be viewed in its proper context—as a first step toward manned orbital and interplanetary exploration missions—the May 5 feat erased the skeptical view of the Eisenhower Administration that Russia will reap all the prestige value which can be obtained from space flight.

The Kennedy Administration, which at first approached space with a caution discouraging to NASA scientists, has reacted to the MR-3 mission in a manner which promises a new level of White House support for the agency. As final preparations were being made for the flight, President Kennedy predicted a "substantially increased space effort," and he called Shepard to congratulate him after the astronaut had been taken to the carrier USS Lake Champlain a few minutes after the shot.

Next step in the Mercury program probably will be another ballistic launch before the end of June (AW May 8, p. 29). All three Redstone pilots—Shepard, Marine Lt. Col. John H. Glenn and Air Force Capt. Virgil I. Grissom—will have an opportunity to fly a ballistic trajectory at six-week intervals. These two flights are designated MR-4 and MR-5, and could be followed by another two MR missions, since NASA has Redstone boosters available for four more such tests. Decision on MR-6 and MR-7 probably will not be made until MR-4 and MR-5 are flown.

Mission preparation and flight profiles for all manned flights will be identical, although capsule procedures may be varied so astronauts can control the capsule over different portions of the trajectory. Shepard said after his flight that he had some recommendations for changes, but they are few and minor. He did not specify whether these changes are in systems or procedures, but emphasized that they will not delay the flight program.

Because the MR missions basically are pilot training and capsule qualification steps toward orbital flight, it is probable that Shepard, Glenn or Grissom will be the first orbital Mercury pilot. From the most optimistic viewpoint, the first manned orbital mission is possible in August. Conservative target date is November.

Orbital Flight Schedule

An August manned orbital flight will require near-flawless MA-4 and MA-5 missions, with no difficulties in preflight, flight or recovery phases. Working under a maximum effort, crews require at least four weeks to prepare an Atlas for a Mercury payload, so launches could be conducted four weeks apart. Mercury-Atlas preflight procedures could take as long as two months, and if this happens, the launch would be in November and would still be predicated on successful MA-4 and MA-5 flights.

NASA's engineering judgment is that the Atlas is capable of launching the manned capsule into orbit, but the Mercury-Atlas program has been plagued by a series of failures. Latest occurred Apr. 25 when the launch vehicle failed to roll to its 70-deg. heading and was destroyed by the range safety officer (AW May 1, p. 30).

The MA-2 test, Feb. 21 (AW Feb. 27, p. 26), was successful in a qualification of the capsule under maximum re-entry, air load and heating conditions. First MA test, with the same

U. S. Record Claim

Cape Canaveral—U. S. is claiming non-orbital records of 117-mi. altitude with a weight of 2,250 lb. in the newly established manned space records division of the Federation Aeronautique Internationale following the May 5 ballistic flight of Cdr. Alan B. Shepard, Jr.

Russian claim for three manned space flight orbital records, based on the Apr. 12 flight of Maj. Yuri Gagarin, is pending. Claim is for orbiting 10,416.63 lb. at an altitude of 186.66 mi. for 108 min. (AW Apr. 17, p. 28). Documentation for the Soviet record claim has not been forwarded to FAI, according to President Jacques Allez.

Documentation for space records, which must be set above an altitude of 100 km. (62.1 mi.), must include a brief vehicle description, including thrust, number of engines and special modifications used. Russia has not yet released details of its booster systems.

Allez and Jacqueline Cochran, National Aeronautics Association representative, were here for Shepard's flight to certify U. S. record claims. Soviet records presumably will be certified solely by documentation.

In addition to a launch vehicle description, documentation must include date, time and latitude and longitude of launch and recovery, plus a statement certifying to the mission by the vehicle commander.

objectives as MA-2, failed on July 29.

The MA-4 flight will duplicate objectives of MA-3 in a single orbit terminated by simulation of an abort at the moment of injection. Second objective will be to qualify the 17-station tracking network under orbital conditions.

Capsule and its systems have functioned successfully throughout the development program, and George M. Low, chief of NASA's manned space flight programs, told AVIATION WEEK that the flight program will not be held up because of delayed capsule delivery.

McDonnell Deliveries

Shepard flew McDonnell Aircraft Co. production capsule No. 7. Delivery has been made on 12 capsules in an order that recently was increased to 26. Original McDonnell contract was for 12 capsules, which was increased to 18, then to 24 and 26.

Low said there is no technical reason now why capsules cannot be flown several times and their systems re-used. NASA originally increased its McDonnell order so that recovered capsules could be analyzed and tested to destruction, but this has not been necessary after all flights. Capsule No. 14 was flown twice in the Little Joe series, and the MA-3 capsule, separated before the Atlas vehicle was destroyed, will be flown as MA-4.

Major subsystems such as stabilization and control, reaction control, environmental, communications and camera could be removed for other flights, or an entire capsule structure could be fitted for use in the planned biomedical program for extended orbital flight (AW Mar. 6, p. 27).

Glare of publicity which preceded Shepard's flight by more than a week was magnified by the three-day delay in launch (AW May 8, p. 29), but the pressure build-up proved to be one of the most fundamental benefits of the shot.

NASA was unable to enforce its news embargo—which prohibits publication of material until after launch—and tacitly lifted the embargo May 3. Because of this, millions of people in the U. S. and abroad were prepared for live commentary and television originating at Cape Canaveral on the successful mission.

Shepard said the pressures of publicity imposed extra burdens on the program and that it was annoying at times, but the justification was "that the free and democratic society which produced us, and which produced the Project Mercury flight, certainly had a right" to observe the flight the way it was presented.

Pattern Set

Webb gave a clear indication that the pattern of presentation for future flights is set, but he said "if we are to have our spectacular successes, openly arrived at, with ever larger and ever more complicated rockets, the early test flights, unmanned of course, will involve some spectacular failures."

Webb pointed to the reliability records of the V-2, with one success in every seven shots; the early Jupiter, seven successes in 10 tries; the Thor, four successes in 10, and Polaris, with a 50% reliability which has grown to 90%.

He urged a "proper perspective" in judging development failures and said no rocket flight can be guaranteed absolutely safe.

Reaction to the astronaut's flight was immediate and graphic. The Deerfield, Ill., school board named a new elementary school after Shepard; several bills have been introduced to present him with a Congressional Medal of Honor; President Kennedy awarded him NASA's highest award, the Distinguished Service Medal, and his achievement was praised by Western nations. Faint praise came from Soviet-bloc countries, with condescending comparisons of the flights of Shepard and Soviet Maj. Yuri Gagarin.

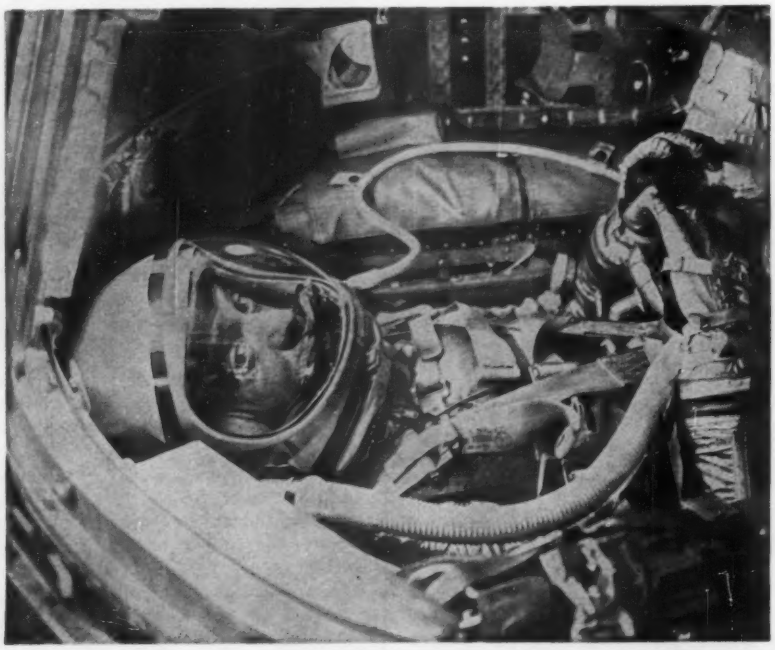
President Kennedy said "all America rejoices at this successful flight of Astronaut Shepard. This is a historic milestone in our own exploration of space, but America still needs to work with the utmost speed and vigor in the further development of our space program. Today's flight should provide incentive to everyone in our nation concerned with this program to redouble our efforts in this vital field. Important scientific material has been obtained during the flight and this will be made available to the world scientific community."

Tribute to Team

Later, the President paid tribute to Mercury Director Robert R. Gilruth and his operations director, Walter C. Williams, to Dr. Hugh L. Dryden, deputy NASA administrator, and to Glenn and Webb.

Soviet Premier Nikita Khrushchev cabled the President this message: "On behalf of the Soviet people and myself personally, I send you and all American people sincere congratulations on the occasion of the successful launching of a rocket with a man aboard, which flew a distance of 300 mi. and during the flight rose to an altitude of 115 mi. The latest outstanding achievement in mastering space opens up unlimited opportunities for studying nature in the name of progress. Please convey my heartfelt congratulations to the flier Shepard."

Former President Eisenhower congratulated Shepard and the "scientists whose work over recent years made this space experiment possible." Vice President Johnson, chairman of the Space Council, praised Shepard's valor and also promised full disclosure throughout the world of the information obtained from the flight. "People everywhere will be deeply pleased by the success of this effort which has pushed



CDR. SHEPARD was in the Mercury-Redstone 3 capsule for about 4 hr. before launch. In the background is the astronaut's survival kit.

the frontiers of knowledge into outer space," he said.

Retired Army Maj. Gen. John B. Medaris, who headed the Army Ordnance Missile Command, called the conquest of space "the greatest natural advertising gimmick since the invention of Coca Cola," and he said Shepard's flight has had the effect of a "giant tranquilizer" on the American public.

Prices of stocks of companies associated with the Mercury project rose significantly immediately after the launch on the New York Stock Exchange. McDonnell Aircraft rose $3 to $39.12, with 64,600 shares sold, fourth highest issue traded.

Scientific Enthusiasm

Enthusiasm extended to the U. S. scientific community and was expressed by many associated with the Mercury project, and some who are not. Dr. Dryden, who originally justified funding the Mercury program and suffered some heavy congressional barbs during the formation of NASA, said Shepard's flight was an experience which could not be obtained any other way. He de-emphasized the purely scientific value of the flight and emphasized the technological advances in materials, devices and procedures which are "at the frontiers of science."

Dr. Theodore von Karman, chairman of North Atlantic Treaty Organization's aeronautical research and development advisory group (AGARD) believes the Mercury shot eliminated any skepticism on the possibility of manned orbital flight. He said the re-entry problem has been solved and accurate guidance into orbit can be obtained.

Western nations expressed elation over the launch, particularly in the open manner in which it was conducted. A large number of foreign news correspondents at Cape Canaveral during the shot were from British Commonwealth countries, and the reaction appeared universally favorable in British newspapers.

The Soviet press, however, took pains to underline that the Mercury achievement cannot be compared with Gagarin's orbital flight. Tass compared Shepard's flight to Soviet ballistic flights with dogs in the summer of 1959.

Prof. Georgy Pokrovsky, identified as a doctor of technical sciences, said the U. S. is following the road blazed by Soviet researchers, and speculated it will probably take another two years for this country to duplicate the Gagarin flight. He added that the U. S. may try an orbital flight earlier.

Gagarin's Flight Defended

Soviet press defends the value of Gagarin's flight by saying the Russian could have controlled his craft as the U. S. pilot did, but this was not necessary. Russia also claims considerable advance notice of the flight had been given.

The Soviets are still showing extreme sensitivity to speculation that Gagarin's flight was preceded by a less successful one in which Vladimir Ilyushin, son of aircraft designer Sergei Ilyushin, was mentally affected and physically injured. Soviet press says Ilyushin was injured in an automobile accident last summer and is recuperating in China.

Flight Proves Man Can Function in Space

By George Alexander

Cape Canaveral—Early data from the first manned Mercury ballistic flight is confirming the belief that man can perform useful functions in the space environment, and it is not likely that later, more precise data analysis will produce information much different from predictions.

Mercury Director Robert R. Gilruth returned here from Washington May 9 to head the team making detailed analysis of tapes and photographs taken on the May 5 Mercury-Redstone (MR-3) flight of Cdr. Alan B. Shepard, Jr. Water C. Williams, operations director, termed the mission "as nearly perfect as we could expect." Marine Lt. Col. John H. Glenn, the alternate pilot, said "everything checked out against the card"—the checklist of time-correlated pilot and capsule functions.

National Aeronautics and Space Administration officials caution that the MR-3 success was only the first flight test in U. S. manned space flight, and additional ballistic and orbital development missions are necessary before the Mercury manned orbital flight can be attempted (see p. 29).

Based on early analysis, Shepard and his capsule underwent these stresses and loads during his 15-min. flight:

- **Weightlessness:** total period of 4 min. 45 sec., time from capsule separation to re-entry was 5 min. 15 sec., and Shepard experienced a 0.05g force during the 30-sec. retrofiring cycle.
- **Peak gravity loads:** 6g launch, and 11g re-entry. Figure is not expected to be off by more than 0.5g when all data is reduced.
- **Re-entry:** cycle lasted about 1.5 min from onset of 0.05g through the 11g peak and down to 1.5g. Shepard experienced loads above 5g for about 0.5 min.

Maximum dynamic pressure of about 550 lb./sq. ft. was encountered at 35,000 ft. altitude, several thousand feet above and two seconds after the capsule-booster combination had passed through the transonic speed region. Aerodynamic buffeting occurred at this point, but it was not greater than had been anticipated. As Shepard passed through this region, he told the control center: "It is a lot smoother now, a lot smoother" (see p. 33). Minimum dynamic pressure and transonic flight sequences were the two areas of major concern in the manned Redstone flight profile.

The 83 ft., 66,000 lb. Mercury-Redstone vehicle lifted off at 9:34:13 a.m. EST. At T-plus-142 sec., an altitude of 196,000 ft. and an attitude of 40 deg. above horizontal, the Redstone-Rocketdyne engine shut down, and the escape tower was jettisoned. Capsule velocity was then 4,500 mph. actual, 5,160 mph. inertial. Booster cutoff was 0.5 sec. early, but well within nominal tolerances.

During the boost phase, Shepard continuously reported to the Mercury control center on the Redstone's fuel supply and flow, his cabin pressure, g loading and oxygen supply.

Ten seconds after engine cutoff, the clamp ring securing the capsule to the booster was released, and three solid propellant rockets, mounted to the base of the craft and developing 350 lb. thrust each, fired to separate the capsule from the Redstone.

The periscope was then extended, and the autopilot swung the capsule around to face the heat shield forward (down range) at an attitude of 14.5 deg. above horizontal. Simultaneously, any oscillations induced by separation were damped by the automatic stabilization control system (ASCS).

With capsule controls still on automatic, Shepard exercised pitch, yaw and roll movements with his hand control stick to get the feel of exertion in a weightless environment. The pilot then switched to manual control of the hydrogen peroxide gas jet system, working one axis at a time—pitch, yaw and roll in that order. Maximum maneuver in any plane was 20 deg. All actions were telemetered back to ground stations for later reduction, analysis and comparison. Shepard reported the zero-g experience as "pleasant."

Shepard reported that he saw through the periscope a fairly extensive cloud pattern along the eastern coast and that he could distinguish

Lake Okeechobee, Fla., Andros Island (one of the Bahamas) and a reef.

Although retrorockets were not required to re-enter this Mercury capsule on its brief, suborbital flight, they were fired to test the operation and sequence of the system. Shepard pitched the capsule up to the 34 deg. retrofiring attitude and began the retro sequence. He ripple-fired the three Thiokol solid propellant motors, each developing 1,160 lb. thrust at 115-mi. altitude. Each unit burned 10 sec., overlapping the firing duration of the preceding motor by 5 sec. During the firing period, Shepard made adjustments to correct the normal wobble induced by the canted angle of the motors. Retrorockets slowed the capsule by 350 mph.

An explosive bolt was fired to sever the steel strap holding the retro pack to the capsule's heat shield and push the entire unit away from the craft. At this point, Shepard encountered the only malfunction of a capsule device: The panel light, which should have signaled that jettison had occurred, failed to turn green. The pilot told Mercury control center: "I do not have a light. I see the straps falling away. I heard a noise. I will use override." Manual override caused the green light to ignite.

The periscope was then retracted and capsule control reverted to the autopilot to establish re-entry attitude.

Shepard tried communications with the HF transmitter and then returned to the UHF channel. As a cross check of his dexterity after 4 min. of weightlessness, he took manual control of the capsule and repeated three-axes maneuvers once more, with the results telemetered back for later evaluation.

At about T-plus-420 sec., the pilot closed his eyes and made a touch test of certain preselected instruments with his right hand—cabin air, telemetry key, a.c. voltage switch, etc. This task was recorded by a 16 mm. camera behind and above his left shoulder.

At about T-plus-490 sec., Shepard induced a roll of 2 rpm. to reduce landing dispersion. At .05g, the pilot knew that the capsule was re-entering the upper limits of the atmosphere; deceleration was rapid, and at the 11g peak Shepard was forced to strain to make his reports intelligible.

Drogue chute and radar chaff were deployed at 21,000 ft., or T-plus-570 sec., and the ambient air snorkel was opened 4 sec. later. At 10,000 ft. and T-plus-600 sec., the main ring-sail parachute blossomed, lowering the capsule at 32 fps. An underwater sofar bomb was ejected to aid recovery forces, the UHF beacon began broadcasting, remaining hydrogen peroxide was dumped and the impact skirt was extended, suspending the heat shield below the capsule.

The capsule landed in the ocean at 9:49 a.m. EST, 7 mi. from the predicted impact point, about 80 mi. east northeast of Grand Bahama Island. A Marine HUS helicopter from the USS Lake Champlain picked up Shepard and the capsule at 9:54 and deposited them on the deck of the carrier at 9:59.

Throughout the flight, only the primary systems were required—there was never a need for a redundant circuit or backup device. Pressures and temperatures varied only slightly—re-entry heating from 95 to 102F and Shepard's suit from 72 to 75F.

The flight was originally scheduled for May 2, but was postponed because of weather (AW May 8, p. 29). On the day of launch, Shepard arose at 1:05 a.m. EST. After a breakfast of orange juice, steak, eggs and toast with jelly, eaten with the other six Mercury pilots, Shepard received a thorough physical exam and was then instrumented. Four electrocardiograph sensors were taped to his chest, a respirometer attached to his neck and a rectal thermometer inserted. He then donned his 20 lb. aluminized suit, and the garment, plus instrumentation, was checked out.

At 5:14 a.m. EST Shepard rode the gantry elevator to the third level and entered the capsule. At 6:10 a.m., the hatch was sealed. Fifteen minutes later, the gantry was rolled back and the cherry-picker, a jointed crane with a small cupola at the end, was rolled to the erect missile for emergency rescue, should trouble develop.

Launch time had been set at 7:30 a.m., but a series of holds occurred. At 7:14, a weather hold was ordered. At 7:47, the control center announced that during the hold a "hot" inverter in the booster had been discovered and would have to be replaced. The gantry moved back to the missile. An inverter in the MR-2 chimp capsule booster became hot and caused a similar hold on Jan. 31.

At 8:40, the count was resumed at T-minus-35 min. At 9:00, the count was interrupted again because of a range computer malfunction, then picked up at 9:17 at T-minus-15 min.

A high pressure control regulator on the booster showed an overage of 100 psi. at 9:30 and the count was stopped for 90 sec. while control center personnel manually dropped the pressure through relief valves, and then raised it to the proper level. Count resumed at 9:31:33 at T-minus-160 and went smoothly from there.

PHOTO taken through the capsule's periscope shows extensive cloud coverage over the ocean and along the eastern coast of U. S.

Shepard's Mercury Flight Communications

Cape Canaveral—Cdr. Alan B. Shepard, Jr. maintained constant voice radio communications with Project Mercury ground stations here and at Grand Bahama Island during his suborbital Mercury-Redstone flight May 5. Sequence began 60 sec. before liftoff and ended after the capsule landed 302 mi. down the Atlantic Missile Range. All ground-originated communications are labeled "Voice."

Voice: One minute and counting, mark. Forty-five and counting, mark.
Shepard: Roger.
Voice: Firing command, 30, mark.
Shepard: Roger. Periscope has retracted.
Voice: That is the best periscope we've got.
Shepard: Main buss 24 volts, 26 amps.
Voice: 15, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, zero. Liftoff.
Shepard: Roger, liftoff and the clock is started.
Voice: . . . (unclear)
Shepard: Roger, reading you loud and clear.
Voice: . . . (unclear)
Shepard: This is Freedom VII, the fuel is go. 1.2G, cabin at 14 psi., oxygen is go.
Voice: . . . (unclear)
Shepard: Freedom VII, it is still go.
Voice: . . . (unclear)
Shepard: This is VII, fuel is go, 1.8G, 8 psi. cabin, and the oxygen is go.
Voice: . . . (unclear)
Shepard: Cabin pressure is holding at 5.5.
Voice: I can understand; cabin holding at 5.5.
Shepard: Fuel is go, 2.5G. Cabin 5.5. Oxygen is go. The main buss is 24, and the isolated battery is 29.
Voice: . . . (unclear)
Shepard: O. K. It is a lot smoother now. A lot smoother.
Voice: Roger.
Shepard: . . . fuel is go, 4G. 5.5 cabin. Oxygen. All systems are go.
Voice: All systems go. Trajectory O. K.
Shepard: 5G. Cap sep [capsule separation]. Green.
Voice: Roger.
Shepard: Auto retro jettison circuit disarm. Cap sep is green.
Voice: Periscope is coming out.
Shepard: Periscope is coming out; and the turn around has started.
Voice: Roger.
Shepard: ASCS [automatic stabilization and control system]. Control movements.
Voice: Roger.
Shepard: O. K. Switching to manual pitch.
Voice: Manual pitch.
Shepard: Pitch is O. K. Switching to manual yaw.
Voice: I understand. Manual yaw.
Shepard: Yaw is O. K. Switching manual roll.
Voice: Manual roll.
Shepard: Roll is O. K.
Voice: Manual roll.
Shepard: Roll is O. K.
Voice: Roll O. K. Looks good here.
Shepard: On periscope. What a beautiful view.
Voice: I'll bet it is.
Shepard: Cloud cover over Florida, three to four tenths in the upper east coast, obscured up through Hatteras. Can see Okeechobee, identified Andros Island, identified the reefs.
Voice: Roger. Count down on retro: 5, 4, 3, 2, 1, retro-angle.
Shepard: Start retro sequence and retro attitude. Green.
Voice: Roger.
Shepard: Control is smooth.
Voice: Roger, understand, all going smooth.
Shepard: Retro 1 fired, very smooth.
Voice: Roger, Roger.
Shepard: Retro 2. Retro 3. All three retros are fired.
Voice: All fired on the button.
Shepard: O. K., three retros fired. Retro jettison on.
Voice: Roger. Do you see the booster?
Shepard: Negative.
Voice: Roger. Switching fly by wire. Fly by wire. Understand.
Shepard: All is O. K.
Voice: Roger.
Shepard: Roger. I do not have a light. [No green panel light lit to indicate retrorocket package has jettisoned.]
Voice: Understand; you do not have a light.
Shepard: I do not have a light. I see the straps falling away. I heard a noise. I will use override.
Voice: Roger.
Shepard: Override used. The light is green.
Voice: . . . retroject?
Shepard: Roger. Periscope is retracting.
Voice: Periscope retracting.
Shepard: . . . going into re-entry attitude.
Voice: Re-entry attitude. Roger. Trajectory is right on the button.
Shepard: O. K., Buster. Re-entry attitude. Switching to ASCS normal.
Voice: Roger.
Shepard: ASCS is O. K.
Voice: Understand.
Shepard: Switching to HF [high frequency] for radio check.
Voice: . . . on HF. Back to UHF. [ultra high frequency].
Shepard: All clear. This is Freedom VII.
Voice: . . . (unclear).
Shepard: 3, 6, 9. O. K. O. K. O. K. [calling off G-stresses].
Voice: Coming through loud and clear.
Shepard: O. K. O. K.
Voice: . . . CapCom [Capsule Communicator], your impact will be right on the button.
Shepard: 30,000 ft.
Voice: CapCom, I can read you now.
Shepard: Roger, Deke. [Astronaut Donald K. Slayton] loud and clear. How me? 25,000.
Voice: Switching over to G. B. I. [Grand Bahama Island].
Shepard: Roger. The drogue green at 21,000, the periscope is out. Good drogue. The drogue is good. Seventy per cent auto, nine-zero per cent manual. Oxygen is still O. K.
Voice: CapCom, can you read?
Shepard: Thirty-five feet per second.
Voice: CapCom, can you read?
Shepard: I read.
Voice: CapCom, how do you read now?
Shepard: . . . CapCom, glad to be here aboard. I am at 7,000 feet. My condition is good. Landing bag green. Descent good.
Voice: Roger.
Shepard: . . . Altitude 4,000 ft. Condition as before . . . Feels good. Will land.
Voice: CapCom, this is Card File 23 [search aircraft call sign].
Shepard: This is . . . CapCom.
Voice: This is two-three, over.
Shepard: . . . Will you please relay. Need information.
Voice: Freedom VII reports good drogue . . . deployed 7,000 ft. . .
Shepard: All O. K.
Voice: Card File 23 from Freedom VII. 4,000 ft.; condition as before. Main chute good. Landing bag deployed peroxide dump.
Shepard: CapCom, everything A-O. K. Dye marker out. Over . . .
Voice: Coming along side now.
Shepard: CapCom is alongside . . . now. Over.
Voice: Astronaut now on board [the helicopter].

Soviet Lead Indicated in Bioastronautics

Washington—Soviet Russia apparently has a lead over the U. S. in bioastronautics that can be coupled with her weight-lifting advantage to permit a week-long manned flight orbiting the earth at any time.

Detailed reports on the flight of Maj. Yuri Gagarin (AW Apr. 17, p. 26) support the belief of some U. S. aerospace medical experts that Russia has done far more to explore space medicine and to develop equipment and techniques for the support of life in space than this country has.

Russia's advantage does not come solely from the ability to put more weight in orbit, in the opinion of these observers. It comes as a direct result of greater effort expended on the biosciences—with extra room and weight allowance in rocket and satellite payloads merely supplying a better tool with which to do the research. Other U. S. experts disagree, holding the view that weight is Russia's only advantage in this area.

Soviet press and radio accounts of the preparation for Gagarin's flight and its execution in the weeks following the initial announcements have attempted to clarify the apparent discrepancies in the early reports, but without admitting that there were discrepancies.

These reports also reveal that:

• **Five-ton spaceships** of the type used for Gagarin's flight can support human life for as long as 10 days. By contrast, the U. S. Mercury capsule is designed to support life for 24 hr. Reduction of the weight of the oxygen bottles for the open-cycle Mercury system to a permissible weight took four months and was one of the tougher subsystem problems in capsule development. Originally, the Mercury program anticipated 24-hr. flights with a life support system that was good for 48 hr. in case of emergency. Increasing oxygen capacity to the level needed for a 48 hr. flight now would require eliminating weight somewhere else in the capsule.

The U. S. has no fully-developed closed-cycle, or regenerative, oxygen system such as the one used in Gagarin's "Vostok" spaceship.

Even if Russia allowed the safety factor of two that was once contemplated for the Mercury life system, it apparently could fly a manned space ship for five days. Descriptions of Vostok state that "the reserves of food, water, recovered substances and the capacity of the electrical power sources are calculated for a flight lasting up to 10 days."

Prolonged effects on man of weightlessness and the relative isolation of such a long flight are not known. But the reports on Vostok point out that Russia proved with the orbital flight of the dog Laika in Sputnik II three and a half years ago that "long periods of weightlessness per se do not disrupt the main processes of vital activity."

• **Sputniks I and III** may have carried living organisms, although Russia did not say so when they were launched. Discussing biomedical research, the Vostok reports note that "biological experiments were continued on early Soviet artificial earth satellites." Soviet reports refer to satellites launched prior to Sputnik IV as "artificial earth satellites," and to the six 5-ton vehicles that began with Sputnik IV and ran through Vostok as "spaceship satellites." All six of these larger vehicles carried varieties of animal and plant life, but until now there have been no references to life on the earth satellites other than Laika's.

• **Atmospheric pressure** and concentration of oxygen in Vostok apparently were maintained at or very near sea level values, a much more desirable situation than the 100% oxygen concentration and 5.5 psia. pressure provided by the Mercury capsule—particularly for prolonged flights. The U. S. chose this pressure-concentration balance for Mercury because of weight limitations. The combination could be used for as long a flight as 24 hr., but not enough is known about the prolonged effects of these abnormal conditions to risk exposing a man to them for several days. Follow-on vehicles such as Apollo will have weight allowances high enough to permit giving the man something much closer to his normal environment to work in.

Whether the only Russian advantage in its Vostok oxygen regeneration and pressurization systems lies in the extra weight allowance is disputed in this country. Some bioastronautics specialists believe the Russians can claim a 10-day capability for oxygen regeneration because they are using superoxide chemicals—which the U. S. has explored but not perfected—to remove moisture and carbon dioxide from the cabin air. The superoxides have a greater capability for removing wastes from the air and liberating oxygen from them than the oxides used so far in this country.

Other experts believe from the information available that Russian scientists are no farther ahead in understanding long-life regenerative systems than the U. S. There seems to be little doubt, however, that the Russians already have fully developed such systems and are using them, whereas the U. S. has not because it does not yet have a vehicle in which to use them.

• **Two methods of landing** were tested before the Vostok flight and Gagarin could have used either. Landing in the cabin portion of the spaceship, using both a liquid braking engine and parachutes as Gagarin did, was tested with Sputniks IX and X last March. These two flights carried dummies in the astronaut's chair as well as animals in the cabin. Gagarin also could have ejected himself and his couch from the cabin after it reached an altitude of about 4 mi. and landed by parachute. Reports do not make clear whether Gagarin would fall free of the couch, but they do say that this system was tested "during launches of spaceships"—presumably Sputnik V, from which two dogs were catapulted safely in a small capsule and recovered last August, landing some 6 mi. away from the main body of the spaceship.

• **Although provision is made** for slowing the spacecraft for re-entry, it is designed to survive descent caused by natural deceleration in the atmosphere in case the braking unit fails.

Soviet reports describe conditions inside the cabin as normal pressure and concentration of oxygen; carbon dioxide concentration of no more than 1.0%; temperature range of 60 to 75F, and relative humidity of 30 to 70%.

Regenerating system is automatic. Only reference to the regenerating

GE Target Contract

Washington—ICBM target nose cones for testing the Army's Nike Zeus antiballistic missile system will be developed and produced by General Electric Missile and Space Vehicle Department under a $10-million Air Force contract.

General Electric will supply 47 target vehicles, including a variety of designs to simulate the different re-entry problems, including decoys, a defense missile is expected to meet (AW May 1, p. 28). These designs will all be in the same re-entry vehicle family, probably based on the Mark 3 vehicle the GE group produced for Atlas and Titan missiles. The target vehicles all will carry miss distance indicators.

Targets will be fired from Vandenberg AFB, Calif., into the Pacific area to be intercepted by Nike Zeus test vehicles fired from Kwajalein Island in a series of tests scheduled to begin in January. Army has bought several Atlases to launch the targets, and others will be flown by Atlas and Titan as part of Strategic Air Command's combat launch training program. Air Force Ballistic Systems Division will manage the target vehicle development program.

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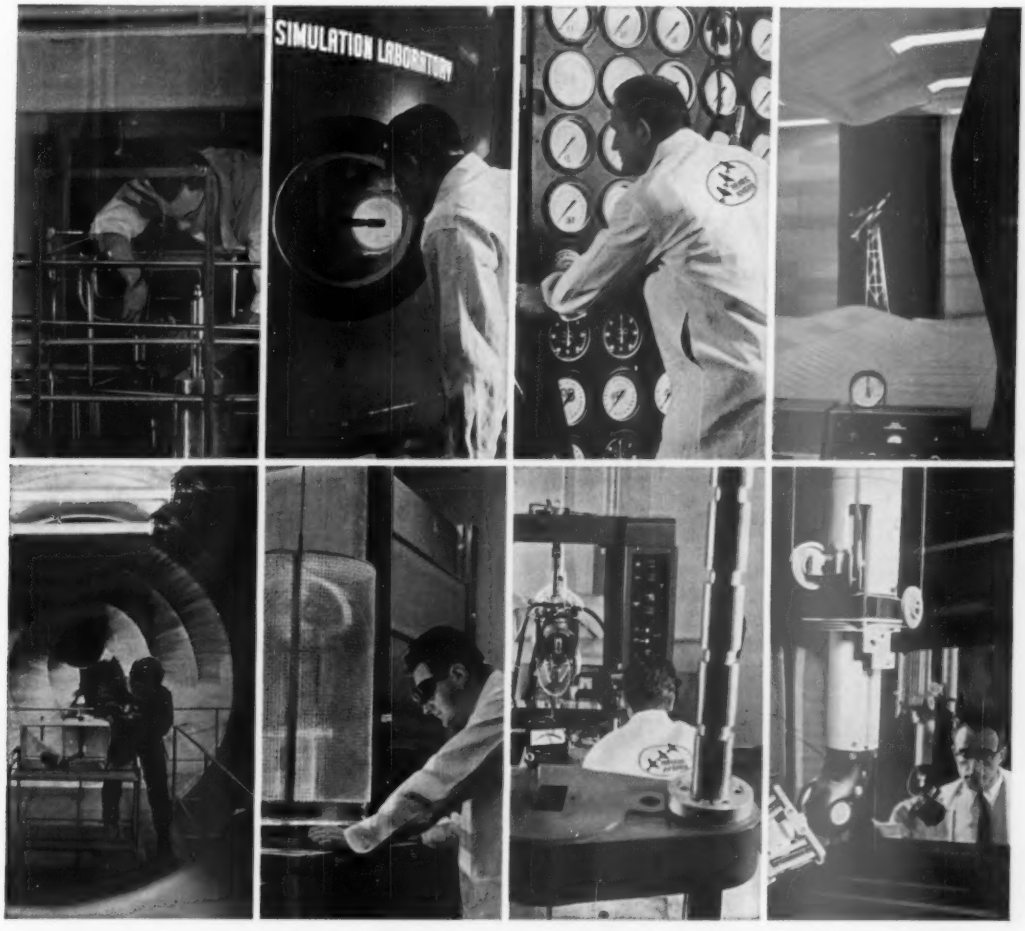

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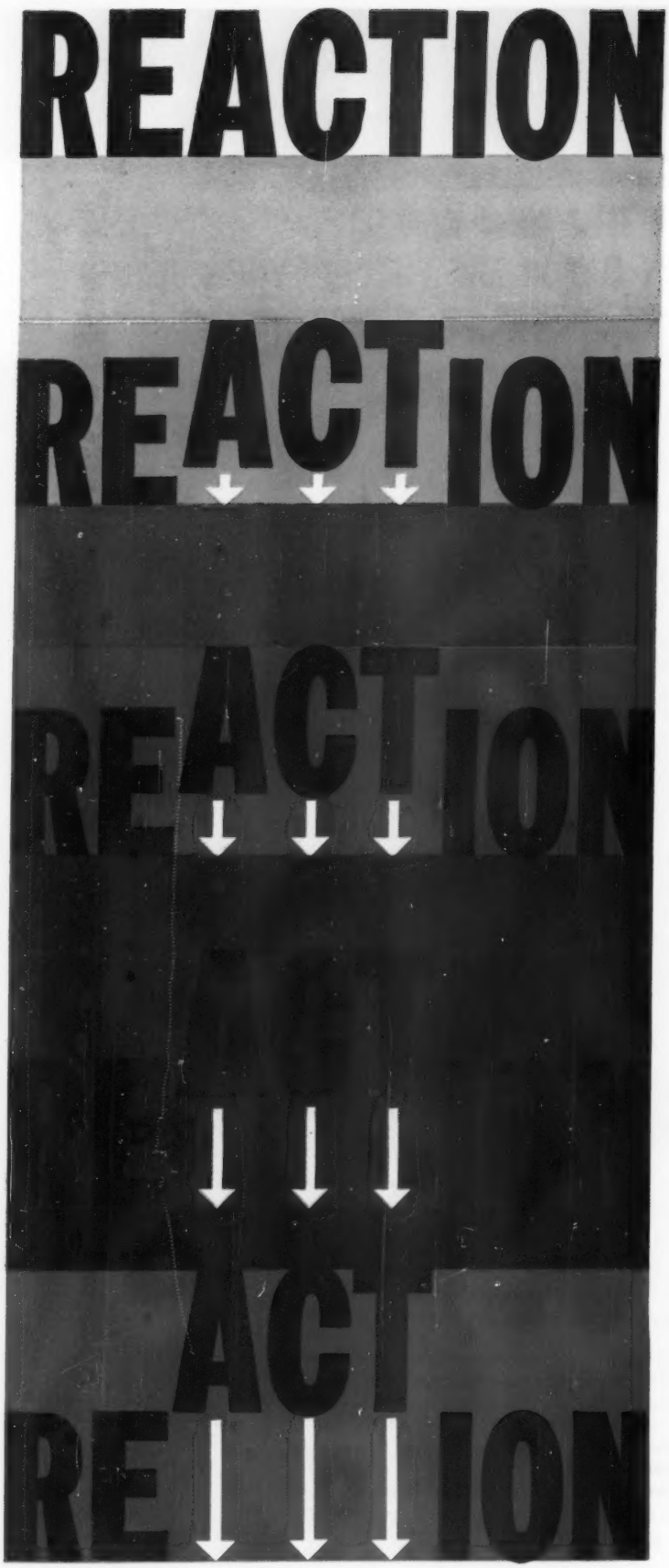

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agents is that they are "highly active chemical compounds." Too high a concentration of carbon dioxide causes a special transmitter to send a signal which in turn causes "an executing mechanism" to alter the work of the regenerator. The mechanism adjusts automatically if excessive oxygen is liberated. Humidity is regulated in the same way, and "special filters purify the air by removing harmful impurities that are thrown off by the human organism and by the machinery."

Heat was regulated by a thermal protective layer on the outside of the capsule; a solar heat exchanger containing a system of shutters on the outer surface; and an automatic thermo-regulating system inside whose distinctive feature, according to the Russian reports, is "a liquid cooling agent." This agent flows from thermo-regulating system into a liquid-pneumatic radiator. Flow of air through the radiator is controlled automatically within the escape apparatus, depending on the temperature, the reports said.

Corrected figures concerning the Vostok flight give its weight as 10,395 lb. instead of the 10,418.63 lb. announced initially. Perigee now is given as 112.47 mi. instead of 108.76 and apogee as 203.2 mi. instead of 187.66. Inclination is given as 64 deg. 57 min. instead of 64 deg. 4 min.

Broadcasts on the day of Gagarin's flight said he had reported his reactions as he flew over South America at 9:22 a.m. Moscow time. Since this was only 15 min. after he was supposed to have been launched, the apparent discrepancy was widely commented on. The later reports omit reference to that transmission, and use 9:51 a.m. as the first specific time reference after launch.

This was the time at which the solar orientation system was switched on as the spaceship emerged from the earth's shadow. One axis of the ship was aligned with the sun by means of optical and gyroscope transducers which sent signals to an electronic unit, which in turn sent commands to a system of steering devices. At 9:52 he was flying in the area of Cape Horn—where the earlier reports had placed him at 9:22.

Gagarin's position was indicated by a globe whose rotation was synchronized with the movement of the ship. For manual control in case of emergency, Gagarin had an optical orientator mounted on one of the portholes. It consisted of two circular mirror reflectors, a light filter, and a glass with a grid—apparently a periscope.

If the craft was correctly oriented, he saw the image of the horizon "in the form of a ring in the field of vision." He could determine orientation of the longitudinal axis by observing the "travel" of the earth's surface, and could turn the ship in such a way that "the horizon line could be seen in the orientator in the form of a concentric ring, and the direction of 'travel' of the earth's surface would coincide with the course line of the grid."

Gagarin was monitored by two television cameras—one showing his full face and one his profile. His radio-telephone system had a magnetic recorder in it to permit taping his speech in flight and transmitting it when he was over ground stations.

Successful MR-3 Flight Handled By Government-Industry Team

Washington — Government-industry team which handled the near-flawless flight of Cdr. Alan B. Shepard, Jr., in the Mercury-Redstone capsule May 5 consists of several thousand contractors and suppliers plus elements of the National Aeronautics and Space Administration, the Defense Department, the Weather Bureau and other government departments.

Robert R. Gilruth manages the program as director of NASA's Space Task Group. STG reports to Dr. Abe Silverstein, director of NASA Space Flight Programs. The Agency's chief of manned space flight programs, George M. Low, has been the major congressional spokesman for Mercury.

STG Members

Members of Gilruth's organization primarily responsible for the first manned ballistic flight include Maxine A. Faget, who established and defined the Mercury concept, including basic vehicle design; Walter C. Williams, who directs Mercury flight operations; Charles W. Mathews, who conceived the operational flight procedures; Charles J. Donlan, Gilruth's primary assistant during the early development cycle of the program, who is now assistant director of Langley Research Center; James Chamberlin, who acts as chief engineer for capsule quality control; USAF Lt. Col. Stanley White, who developed the medical operational procedures; G. Merritt Preston, responsible for capsule pre-flight checkout at Cape Canaveral, and Christopher C. Kraft, flight director in charge of the control center.

McDonnell Aircraft Corp. directs the efforts of more than 2,000 subcontractors as prime NASA capsule contractor. Management responsibility in the company rests with Walter Burke, vice-president for Project Mercury, and John Yardley, director of Mercury operations at Canaveral.

Main subsystem contractors for the capsule are:

- **Attitude stabilization and control,** Minneapolis-Honeywell's Military Products Group.
- **Reaction control,** Bell Aerosystems.
- **Life support and environmental** control, Garrett Corp.'s AiResearch Manufacturing Division.
- **Parachute recovery,** Northrop Corp.'s Radioplane Division.
- **Camera monitors,** D. B. Milliken Co.
- **Communications,** voice, telemetry and emergency, Collins Radio Co.
- **Periscope,** Perkin-Elmer Corp.

Capsule structure is essentially titanium furnished by Titanium Metals Corp. of America, covered with nickel-cobalt shingles produced by Haynes Stellite Co., a division of Union Carbide Corp. Mercury-Redstone capsule re-entry shield is a 350-lb. heat sink of beryllium made by Brush Beryllium Co.

Shepard's full-pressure suit was made by B. F. Goodrich Co.

Pilot of the Marine Sikorsky HUS helicopter which recovered Shepard and his capsule after landing was Lt. Wayne Koons. Lt. George Cox, co-pilot, operated the winch and hooked the capsule.

Recovery force was commanded by Rear Adm. F. V. H. Hilles from the control center, with Rear Adm. G. P. Koch commanding the recovery area task force from the carrier USS Lake Champlain. Navy units were six destroyer-type ships, two mine craft, a salvage and rescue ship, five Lockheed P2Vs and the Marine helicopters on the Lake Champlain. Air Force furnished two Grumman SA-16 search aircraft.

Range Support

Range support included Air Force, Pan American and Radio Corp. of America personnel and facilities commanded by Col. Robert S. Maloney, deputy commander for range, Atlantic Missile Range.

Dr. Kurt Debus of NASA's Launch Operations Directorate headed the Redstone vehicle launch team. The booster system, a modified version of the Army's tactical field missile, was developed by a team headed by Dr. Wernher von Braun at NASA's Marshall Space Flight Center in Huntsville, Ala. Dr. J. P. Keutner is the Mercury project chief there.

Redstone 78,000-lb. thrust engine is produced by Rocketdyne Division of North American Aviation, Inc., and Chrysler Corp. manufactures the booster systems. Ford Instrument Co. manufactures the major portion of the Redstone control system.

Escape Velocity Capability Doubted For Air-Breathing Orbiting Vehicle

Washington—Air-breathing orbital vehicles cannot attain sufficient velocity to escape from the earth's gravitation and perform a space mission, according to Dr. Theodore von Karman.

Dr. von Karman believes propulsion other than liquid hydrogen-liquid oxygen will be needed to increase a vehicle's speed from 25,000 fps. to the 28,000-30,000 fps. required for escape.

He indicated that some form of nuclear or nuclear-electric power will have to be employed. He also predicted that electromagnetic phenomena eventually will be used in space propulsion systems.

Air Force Office of Scientific Research last week sponsored a program of lectures marking the 80th birthday of Dr. von Karman, an aeronautical pioneer who currently is chairman of North Atlantic Treaty Organization's Advisory Group for Aeronautical Research and Development.

Dr. von Karman was one of the early proponents of an air-breathing orbital vehicle, which the Air Force has sponsored in study form first as Space Plane and later as Aerospace Plane (AW Oct. 31, p. 26). Several companies are undertaking their own unfunded studies.

The manned space vehicle is a necessity, he said. "I do not believe in an automatic pilot. Decisions will always have to be made by a man," he added.

Dr. von Karman, whose technical endeavors stem from the early 1900s, considers the development of supersonic flight as the greatest advance—leading to further developments whose potential has yet to be realized, especially in global transportation.

"When the Wright brothers flew, neither they nor anybody else thought that a great industry would come from it," he said. "Likewise, space flight will become an industry. Not that you will want to spend a vacation on the moon, but scientific effort will support it."

Weapon Vulnerability

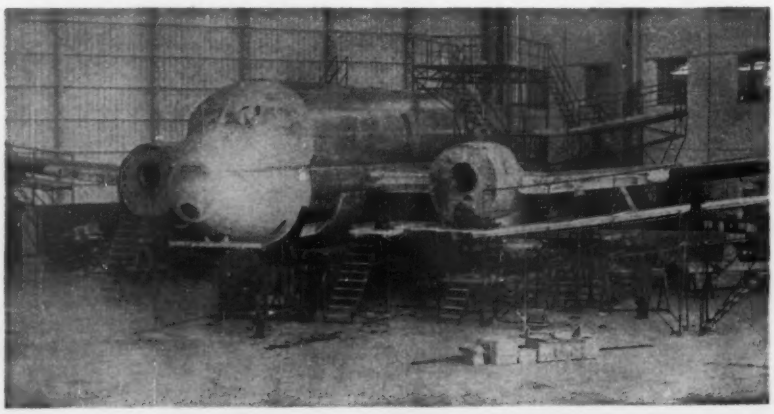
Commenting on the mobility an vulnerability of weapon systems, Dr. von Karman said that space provides room for an extension of the mobility of earth-based systems. He believes that missiles based on railroad cars are vulnerable and also believes that the Polaris submarine-launched ballistic missile is restricted in area and that anti-submarine warfare research will make Polaris less useful in the future.

On the question of whether a missile gap exists, he said that the situation is not very dangerous, but that space deterrent systems will have to be developed and this can be done in three to five years. A crash program can produce them in that period, he said.

Powered by four Turbomeca Turmo IIID turboprops delivering 1,250 hp. each, Breguet 941 STOL prototype rolls out of factory in preparation for initial flight at Paris air show opening May 26. Type 941 uses vectored slipstream principle to achieve STOL capability. Aircraft has a 950-mi. range, cruising speed of 250 mph. Pressurized passenger version, the 942, will carry 45 passengers (AW Nov. 14, p. 65).

Breguet Readies STOL 941, Atlantic 1150 for Flight

Breguet 1150 Atlantic anti-submarine aircraft, jointly financed by five NATO countries (AW Jan. 25, 1960, p. 35), is scheduled to make its first flight in October. Two prototypes are under construction in Breguet's main plant in Toulouse. Aircraft will be powered by two Rolls-Royce Tyne turboprops and grosses 86,000 lb. Span is 124 ft., length 90 ft., and wing area is 1,292 sq. ft. Plane is a midwing, land-based aircraft carrying a crew of 12. Cruising speed of the aircraft is estimated at 375 mph. (AW Feb. 8, 1960, p. 121).



News Flow 'Shocks' McNamara; He Will 'Re-educate' Contractors

Washington—Defense Secretary Robert S. McNamara is "shocked" at the volume of "security" information that has been released in the past and—with strong support and prodding from Senate Armed Services Committee—he intends to close the door.

In testimony to the committee, released last week, McNamara described the "direct objective" of his program as "the reduction in the release of information that is of benefit to our potential enemies." Explaining security difficulties, he said:

"I start this program with a tremendous library of [already released] information already existing, you see, and with precedents here that are very difficult to overcome, and with the need to re-educate 3.5 million members of the Defense Department, plus an untold number of the press, plus all of the contractors in the country . . .

"To change 15 years of precedents and to close the doors to the library overnight is impossible. You cannot do that. So we have to move in, move in gradually and intelligently . . ."

McNamara noted that to do the job he has assigned Lt. Gen. Joseph F. Carroll, Air Force inspector general, "who is presently working within 50 ft. of my desk . . . and working full time on it, and going to stay full time on it until we hopefully develop an efficient program."

The assignment of Gen. Carroll is understood to have been triggered by an Air Force "leak" of information that Secretary of State Dean Rusk advocated stronger conventional military forces to reduce reliance on nuclear strategic weapons. The Carroll appointment aroused widespread editorial comment that it signaled a sharp curtailment in defense information. In general terms, McNamara denied this in a letter to Rep. John Moss (D.-Calif.), chairman of the House Government Information Subcommittee.

Apparently referring to the Rusk episode, McNamara told the committee: "I have already moved in that area, and there will be no more information on that area."

McNamara explained: "I propose to move rather silently in this field. Instead of a direct attack."

Sen. Richard Russell (D.-Ga.), the committee chairman, told McNamara "do not be frightened . . . by an editorial" and volunteered "to take the floor of the Senate" and support McNamara's program.

McNamara objected to skeptical reports on weapon capabilities.

"Why should we tell Russia that the Zeus developments may not be satisfactory?" he asked.

"What we ought to be saying is that we have the most perfect anti-ICBM system that the human mind will ever devise. Instead the public domain is already full of statements that the Zeus may not be satisfactory, that it has deficiencies. (Security deletion.) I think it is absurd to release that kind of information to the public."

McNamara said he is "shocked" not because the Pentagon's Security Review Office makes so many but because it makes "so few" deletions. In one instance, he related, it was eight o'clock at night when he obtained a cleared extract of his congressional testimony for public release. Even at that hour, he said, "there was still so much in it that I sent it back. I cut out a lot of material and sent it back.

"They said, 'It is silly to send it back for review and eliminate this because it has already been made public. If it has been said once, why not say it again?' But we have to start some place so we started that night . . . eliminating."

McNamara related another instance in which he launched an investigation of an unidentified major general for stating the operational date of a new weapon in a press dispatch.

"But I found out that the general had not acted improperly," McNamara said. "In the first place, his speech had been cleared by the security office involved. In the second place, he was simply repeating information that had been released last July by another Defense Department spokesman, and it was not the spokesman's fault. It is the fault of the rules and procedures that we have. . . ."

News Digest

Convair B-58 supersonic bomber, flown by USAF Maj. Elmer Murphy, became eligible for the Bleriot Cup award last week by flying a 669.4-mi. closed course at a sustained speed of 1,302 mph. for 30 min. Award was established by the Aero Club of France for the first aircraft to fly 2,000 kph. (1,243 mph.) for 30 min.

Sperry-Rand Corp. was chosen last week to outfit two Mobile Atlantic Range Stations (Mars), based on two C-4 ship hulls. Bidders with Sperry-Rand were Remington-Rand Univac, American Optical Co., International Telephone and Telegraph Laboratories and Bethlehem Shipbuilding Co. Final selection of subcontractors will be made later.

Army has decided to buy the French Army-developed Entac anti-tank missile system. Missile and launcher weigh 37 lb., and missile is wire-controlled. Entac will replace the Nord SS-10.

Blue Scout I three-stage probe, carrying a 90 lb. recoverable capsule and scheduled to reach 900-mi. altitude and travel 1,350 mi. down the Atlantic Missile Range last week, veered after 76 sec. of flight and second stage ignition, requiring destruction by the range safety officer.

Navy set a manned balloon altitude record of 113,500 ft. May 4 in a two-man, open gondola stratolab flight piloted by Cdr. Malcolm D. Ross. Lt. Cdr. Victor A. Prather, Ross' medical officer-observer, drowned when he slipped from a helicopter hoist as he was being lifted from the gondola. Previous record of 101,516 ft. was set by Air Force Maj. David G. Simons in 1957.

El Al Israel Airlines has ordered two 720B turbofan jets at a cost of $14 million with spares. The order is subject to approval by the Israeli government. Delivery is scheduled for early 1962.

First B-52H was delivered to 379th Strategic Wing, SAC, Wurtsmith AFB Mich., May 9, by Boeing-Wichita. Six SAC bases are scheduled to receive the P&W TF-33 turbofan-powered version of the Stratofortress.

Kaman Aircraft Corp. has established Kaman Skymotive as a new division to become the State of Connecticut's fixed-base operator at Bradley Field, between Springfield and Hartford.

Soviet Record Claims

Russia is claiming aircraft altitude record of 112,205 ft. on the basis of an Apr. 28 flight of the turbojet, delta wing E-66, believed to be the Sukhoi fighter, and a speed record of 466 mph. for propeller-driven aircraft, based on a closed course flight by a turboprop An-10A. U. S. holds existing records of 103,395 ft., set by USAF-Lockheed F-104G, and 436.996 mph., set by North American F-51. Soviet has never documented records claimed for the E-66. Federation Aeronautique Internationale certification committee will consider the claims next month at the Paris Air Show.

Fare Increase Depends on Tax Action

Transportation, fuel levy changes are key factors; airlines asking extension of temporary surcharges.

By Robert H. Cook

Washington—Airlines are resisting any temptation to request new fare increases now, despite White House pressure for tax measures which they claim could pose a serious threat to the industry's already weakened financial condition and inhibit plans to attract a greater volume of business with a series of low fare proposals.

Current strategy of the carriers is to hold the line at present fare levels by asking the Civil Aeronautics Board to extend a temporary increase of $1 per ticket plus a $10 transcontinental jet surcharge, granted last year, beyond the expiration date of June 30.

Airline spokesmen point out that approval of this extension, considered likely, would permit the industry to retain nearly $100 million in operating revenues, while awaiting the outcome of the two important issues which could affect any future fare structure. One is congressional action on a Kennedy Administration proposal to retain the 10% transportation tax on air fares, increase the aviation gasoline tax and add a new tax on jet fuel. The second is the court appeal of CAB's decision in the General Passenger Fare Investigation Case.

Both the airlines and CAB have been placed in critical defensive positions by these issues, which could have a powerful impact on the industry by forcing a general overhaul of the current fare structure and by increasing interest in mergers by airlines in borderline financial condition.

In hearings which began last week before the House Ways and Means Committee, airlines were aligned with the CAB in strong opposition to the Federal Aviation Agency, which urged Congress to pass the Administration tax measures to offset the cost of operating the federal airways system.

Hearings before this committee are scheduled through June 9, after which the House must act and pass the legislation on for Senate action. But it is generally conceded that Congress will approve the tax plans before adjourning.

While most CAB members have urged the airlines to concentrate on offering lower fares as a stimulus to traffic growth instead of attempting to bolster revenues by fare increases, some of them concede that any added tax burden would probably trigger a series of fare increase applications. The Board is acutely aware of the industry's worsening financial condition, and one CAB spokesman said "We'd probably have to go along with an increase, as long as they made a good case for their claim."

The Board's decision in the General Passenger Fare Case, which arrived at a reasonable rate of return of 10.5% but did not set corresponding fare levels, came under fire from Eastern Air Lines in the U. S. Court of Appeals.

Eastern took the position that by not delineating exactly what it considered a "reasonable and just" fare level, CAB failed to accomplish its major purpose in instituting the investigation four years earlier. Contending that the airlines accepted several interim fare increases "in the belief that more would be forthcoming" the airline said it had been financially damaged by the CAB decision.

"What confidence can stockholders, or prospective stockholders, have in an industry where the responsible regulatory agency says it will not, or can not, do its duty to assure fair and reasonable prices?" Eastern asked.

CAB, with support from American, Braniff, United, Continental and Western, replied that one of the major reasons it had not made any mandatory fare recommendations was that Eastern, during a pre-hearing conference, had clearly stated that the then current fares seemed reasonable "for the immediately foreseeable future" and that airlines should be allowed the flexibility to adjust their fares to changing conditions particularly in view of the industry's transition into turbojet equipment. CAB attorneys added that a majority of airlines concurred in this finding and that the Board was unable to select any appropriate future fare levels because there was too little actual turbojet operational experience then on which to base any definitive analysis. The final order in the case did not change any existing rates, CAB said, and Eastern failed to prove that it had been adversely affected by the decision.

Asking the court to dismiss the Eastern appeal, CAB pointed out that if the airline needs a fare increase, it still has the legal right to file for a higher tariff. Last year, Eastern had a $3.7-million loss, while the intervening carriers in the court case experienced profits ranging from $1.1 million, Braniff, to $12.1 million, American.

CAB could be put in a defensive position if the court supports Eastern and remands the General Passenger Fare Case to the Board. Any tariff filings for higher fares submitted by airlines on the strength of such a court order would probably result in a Board order for suspension and investigation to gather data on the costs of the airlines' turbojet operations. This could result in another general fare investigation, excluding only the issue of a fair rate of return and other accounting formulas already set forth by CAB, and forcing CAB to deal specifically with jet operation costs.

CAB emphasized its concern over the airline industry's financial plight in a letter to the House committee, urging that any approval of a fuel tax increase be conditioned on removal of the present 10% transportation tax. Addition of the fuel tax, which the Board estimated would cost the industry $34 million next year, would require the airlines to earn estimated profits of more than $200 million before taxes in order to realize the 10.5% return already approved by the Board.

"Under the present conditions, there appears to be no prospect for such an improvement in the carriers' operating position," the CAB said, emphasizing that imposition of the fuel tax without removal of the transportation tax, would force the airlines to seek higher fares which would tend to further restrict traffic volume, depress load factors and cause a further decline in earnings. CAB emphasized that repealing the transportation tax would result in a "stimulus to travel," needed now because of excess turbojet seat capacity.

Airlines, however, do not generally regard possible repeal of this tax as a means of lowering fares. The philosophy expressed by many carriers is that repeal would then permit a modest fare increase of 5% or less, improving the carriers' financial position while offering the public a lower total fare.

Airlines told the House committee that if the Administration's tax proposal had been in effect last year, it would have converted the trunklines'

over-all $1.2-million profit into a $12 million loss. Forecasting that the tax could cost the industry $56.5 million in Fiscal 1962 and $78.3 million the following year, the airlines termed these costs as "far beyond the rosiest estimates of airline profits."

Strong recommendations by the Federal Aviation Agency that the tax be adopted as the only "equitable means" of recapturing part of the annual cost of maintaining the federal airways system also brought criticism from the Air Transport Assn.

The agency's comments on airline fares were "particularly outrageous," ATA President Stuart G. Tipton said, since the subject is properly a matter of industry economics reserved to CAB. He also criticized publication of the report "on the eve of the hearings," when the airlines would not have had time to study it.

Key elements in a 96-page FAA report were:

• **General taxpayer** is being penalized by the mounting cost of operating the federal airways system, which is expected to reach an annual operating cost of $479 million in Fiscal 1963, with substantial increases forecast for following years.

• **"While the tax is considered"** the most equitable method of apportioning costs among the groups that derive special benefits from the system, an across-the-board fuel tax would still recover less than the total operations costs. Gasoline is now taxed at 2 cents per gallon. Jet fuel, now untaxed, would be taxed 2 cents, with the tax rate on both fuels raised one-half cent a gallon each year until total tax revenues balanced all costs allocated to the users. FAA estimated the proposal would bring in 17.9% of these allocable costs in Fiscal 1962 and 32.1% in Fiscal 1966, when the tax would reach four cents a gallon.

• **Airlines could seek fare increases** if their net profits were inadequate to pay the taxes. FAA estimated that the carriers could meet the tax increase by raising fares no more than 1.60% in Fiscal 1963, based on a 550-mi. trip length.

Calling for a detailed congressional study to coordinate any tax increase with the industry and the regulatory agencies, Tipton warned that any added costs of the tax would probably be passed on to the public, indirectly through subsidy or directly through higher fares. In the past two fiscal years, he pointed out, the gas and transportation payments made by the airlines amounted to more than was required to operate, maintain and amortize the airways system. These costs totaled $661.4 million, while airline taxes totaled $664 million during the same period.

Board Approves Sale by National Of Exchanged Pan American Stock

Washington—Civil Aeronautics Board gave National Airlines permission last week for public sale of its 400,000 shares of Pan American World Airways common stock and ordered Pan American to submit a plan before June 5, for the sale of its 400,000 shares of National stock.

The two blocks of stock were exchanged on an even basis in 1958 (AW Sept. 15, 1958, p. 38) when the quoted value of each on the New York Stock Exchange was about the same. The agreement also involved mutual lease of aircraft, which permitted National to introduce turbojet equipment on its key New York-Florida route well ahead of its competitors, Eastern and Northeast.

The original agreement also gave Pan American an option to buy 250,000 shares of additional National stock at $22.50 per share, which was to provide equity capital to help National purchase needed turbojet equipment. Last year, the Board ruled against both the option and stock trade on grounds that the agreement violated anti-trust laws and gave Pan American control of National.

Under the Board order last week, National now has the right to dispose of its Pan American holdings through a group of underwriters headed by Merrill Lynch, Pierce, Fenner and Smith. Late last week, Pan American's stock was quoted at 18⅞, and the listing had ranged from a 1961 high of 21⅞ to a low of 17¼.

National's stock was quoted at midweek at 14⅜. Range for the year has been a high of 16½ and a low of 10.

In its order giving National the right to divest itself of the Pan American stock, the Board made comment on the difference in prices:

"The disparity in market values and in the returns each carrier may realize on their original expectations by disposition through sale is a risk the carriers assumed. The risk was unavoidable if, as the Board determined, the carriers were to have the option to sell pursuant to their own individual plans for divesture. Therefore, the fact that at this juncture, a disparity in the market values of Pan American and National exists affords no appropriate basis for deviating from the provisions of the Board's order."

In July, 1960, the Board issued an order which gave the two carriers 60 days in which to either mutually return the stock already issued or present "their joint or several plan or plans for its divesture by sale to be carried out within two years." The deadline was extended several times because the carriers were unable to agree on a joint plan.

National chose to sell its Pan American stock, which resulted in bitter disagreement between the two carriers. An exchange of correspondence between the two airlines, involving charges and counter charges, failed to bring about agreement, and National filed its plan to sell the stock by making a public offering through underwriters.

Pan American asked the Board to direct the carriers to re-exchange the stock, a petition which drew the support of the Bureau of Air Operators. In its order last week, the Board denied the request for an enforced exchange of the stock and ordered Pan American to submit its plans to dispose of the National stock.

In this connection, the Board agreed that the most rapid and positive method of stock divesture would be through immediate re-exchange of the stock, but added that "the obligations of the Board . . . could be satisfied by the alternate method of divesture by sale, and that the choice of the method of disposal of the applicants' respective stock interest in each other should be their decision."

The CAB emphasized that its order does not require that each carrier must sell its stock under the same plan. It added that "there is no reason why each of the carriers cannot proceed with appropriate sale by the best method which is suited to each."

Arbitration Agreement Ends National Strike

Washington — National Airlines' scheduled service returned to normal last week following an agreement by the carrier and the International Assn. of Machinists to submit their labor dispute to binding arbitration.

The action, which was proposed by Labor Secretary Arthur Goldberg (AW May 8, p. 39), ended a six-day IAM walkout which grounded the airline and idled some 4,000 officers and employes. Goldberg named Prof. Nathan Feinsinger, chairman of the committee established to make recommendations on the dispute between the flight Engineers International Assn. and the airlines, to serve as arbitrator.

Under the plan, Feinsinger must begin arbitration of the National-IAM dispute no later than June 1.

Report on the engineer dispute is due May 24.

British United Airways Places First Order

By Herbert J. Coleman

London—First firm order for British Aircraft Corp.'s BAC 111 short-haul twin-jet transport was placed last week by British United Airways, the United Kingdom's largest independent airline, which is applying for a share in about 24 routes now held by Britain's two state-owned airlines, British Overseas Airways Corp. and British European Airways.

British United has contracted to buy ten BAC 111s for an initial cost of $22,400,000 and has an option on five more airplanes. First deliveries will be made in the fall of 1964. Aircraft will replace 11 Vickers Viscounts.

In addition, a strong sales effort by BAC in the U. S. has resulted in a letter of intent to order five BAC 111s by Ozark Air Lines, and "considerable interest" by Continental Airlines to replace its Viscount 810s. A Continental engineering and operational team will inspect the airplane here next month and will make a decision within 90 days, according to Sir George Edwards, BAC executive director (aircraft).

Sir George added that production is now under way on the first batch of 20 airplanes with unit costs set at about $2.2 million per airplane. Discussing production costs, Sir George said that the government is prepared "in principle to contribute to the launching cost of the project," noting that he did not know to what extent and couldn't say if he did.

The BAC 111 is a larger version of the Hunting 107 twin-jet first proposed two years ago and bears the same general configuration. Sir George said investigation has proved there is a market for the 107 as a "lighter, more austere aircraft than the 111" and that the corporation would proceed with this version subsequent to BAC 111 production.

Major difference is in the powerplants. The BAC 111 will have two Rolls-Royce Spey RB.163-1 turbofans of about 9,850 lb. thrust each while the BAC 107 will be powered with two Bristol Siddeley BS 75 turbofans of 7,350 lb. thrust each. A Braniff Airways team recently concluded a survey of the 107; no decision has been made.

Designed to operate at a lower cost level than the Viscount, the BAC 111 will fly at a normal cruising altitude between 20,000 and 30,000 ft. and will require no more than 4,800 ft. for takeoff at its maximum weight under standard conditions at sea level. To further reduce the aircraft's direct operating costs, the transport also will have an auxiliary power unit, eliminating the need for expensive ground equipment for air conditioning and starting and reducing the scheduled turn-around time, BAC said.

Direct operating cost analyses of the BAC 111 show that the aircraft is cheaper to operate on a plane mile basis than the Viscount 810 on stage lengths beyond 200 mi. The cost saving averages about 10 cents a mile, BAC said, and at a range as low as 100 mi., the BAC 111 has a direct operating cost of about $1.50 a plane mile.

Direct seat mile costs of the aircraft, at a 75-seat configuration, decrease from 2.6 cents at 100 mi. to 1.4 cents at 750 mi. range, based on U. S. costs and Air Transport Assn. cost assumptions. BAC estimates that in the 69-seat configuration, the transport's seat mile costs would be reduced another 17%.

Breakeven passenger load, using the ATA formula with indirect costs equaling direct costs and based on revenues of seven cents a passenger mile, would be 31 passengers at 200 mi. ranges, 26 at 400 mi., 22 at 600 mi., and 21 at 800 mi. This puts the breakeven load factor below 50% at all ranges above 200 mi., BAC said.

Maximum use is being made in the BAC 111 of the detailed engineering and systems knowledge which has gone into the civil aircraft already produced by BAC companies, which include Bristol Aeroplane, English Electric, Vickers and Hunting. Among these techniques are the use of Vanguard and VC. 10-type wing panels machined from solid metal and a fail-safe design philosophy providing for duplication of many components so that failure of one structural element will not be disastrous, the company said.

The British United order is the second recent move by a British independent into the pure jet field. Cunard Eagle last week signed a $16.8-million order, including spares, with the Boeing Co. for two 707-420 jet transports (AW Apr. 10, p. 51) for use on the London-New York route for which it has applied. The application is being contested by BOAC in hearings set for this week. Cunard Eagle, which also is considering purchase of the Vickers VC. 10, said the Boeing order is not contingent on granting of the North Atlantic route; the airline has taken an option on a third 707 with the first two delivered early in 1962.

BUA's order for the BAC 111s is not conditional on approval of its various route requests in the European market, according to F. A. Laker, the airline's executive director. He stressed that British United needs the 10 BAC 111s to "continue its existing business" and that the airline will supplement the order if it gets favorable decisions from the Air Licensing Board.

British United previously had shown interest in the de Havilland DH 121 Trident three-engine jet, but Laker said studies led BUA to believe that the BAC 111 would provide more flexibility as a replacement for Viscounts. Other factors influencing the BUA decision, he pointed out, were:

- **BAC 111 will need less** ground time, resulting in lower block times.
- **Engine noise level** will be lower because of the two-engine configuration and shorter takeoff distances.
- **Short takeoff and landing** distances make the BAC 111 more suitable for airports that British United is likely to use. Seat-mile costs will be lower than the Trident, or the Boeing 727 three-jet transport.
- **Smaller airplane will allow** for more personalized service by three stewardesses because "larger airplanes now have the passengers herded on like cattle."

Laker explained that when British United posed its basic requirement for pure jet equipment, it told BAC the airplane must fly from London to Malta against a 14-kt. headwind, carrying 67

BAC 111 Specifications

Powerplant	2 RB.163-1 Speys
Length over-all	93 ft. 8 in.
Wingspan	88 ft. 6 in.
Wing area	980 sq. ft.
Aspect ratio	8
Wing sweep on ¼ chord	20 deg.
Wheel track	14 ft. 3 in.
Tire pressure at max. weight	120 psi.
Total cabin length including toilets and galleys	53 ft. 9 in.
Total cabin length between toilets	44 ft. 6 in.
Interior height	6 ft. 6 in.
Interior width at arm-rest height	10 ft. 4.3 in.
Main passenger door size (forward)	5 ft. 6 in. x 2 ft. 9 in.
Height to passenger door sill	6 ft. 8 in.
Freight doors	3 ft. 6 in. x 2 ft. 7 in.
Height to freight door sill (forward)	3 ft. 4 in.
Height to freight door sill (aft)	4 ft.
Capacities:	
Fuel (8 lb. per Imp. gal.)	18,000 lb.
Freight volume	500 cu. ft.
Weights:	
Max. ramp weight	66,300 lb.
Max. takeoff weight	66,000 lb.
Max. landing weight	62,500 lb.
Max. zero-fuel weight	56,000 lb.
Design max. payload	14,000 lb.

For BAC 111

passengers and arriving with adequate reserve fuel. Laker said the BAC 111 fits this requirement. Malta was selected as the optimum base because BUA considers it the most difficult airport in Europe for operating conditions.

British United would use the BAC 111 on all the European year-round services it has requested, plus seasonal holiday runs. The airline has applied for six routes to Africa and the Far East but Laker said larger jets would be needed for these. British United has shown some interest in the Vickers VC. 10 but Laker emphasized that no decision has yet been made in regard to this aircraft.

BAC has formed a U.S. company, British Aircraft Corp. (USA), to promote both its military and civil products.

President of the U. S. organization will be Christopher Clarkson, formerly U. S. representative for Vickers-Armstrongs. M. P. White, former vice president of Vickers-Armstrongs, has been named executive vice president.

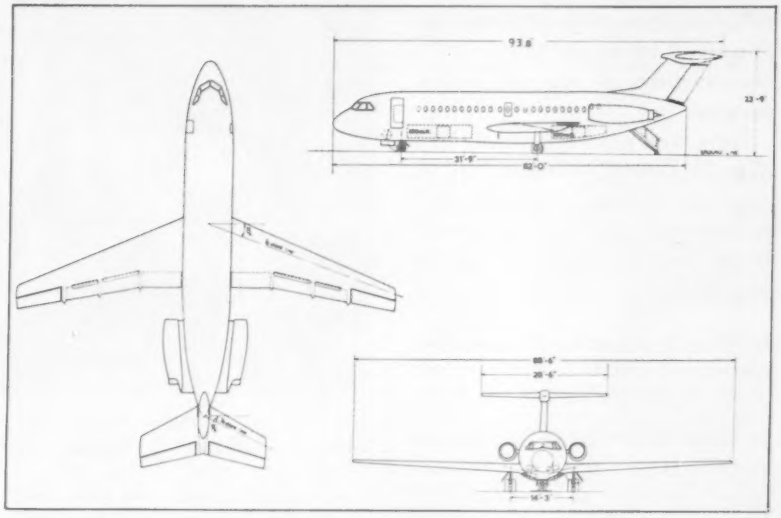
Other officers include Air Marshal W. C. Sheen, director of military sales; W. M. Ehart, manager of press and public relations; Frank C. Hydes, director of technical sales; and Fred R. Chilman, secretary and treasurer. Headquarters of the new company will be in Arlington, Va., a Washington suburb.

Operationally, the BAC 111 will carry 57 mixed-class passengers and baggage at 540 mph. for stages of 800 stat. mi. with a two-hour fuel reserve. On medium hauls, it will carry 43 passengers for 1,200 stat. mi., about equal with the Viscount 800. For short hauls, the BAC 111 can carry up to 69 passengers for 450 stat. mi., plus reserves, or 57 passengers and 2,000 lb. of freight. Best speed for economy and range will be 500 mph.

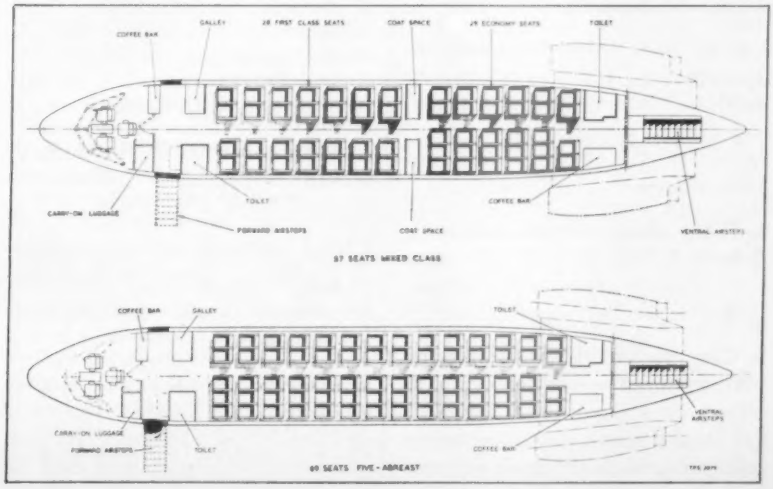
All design and manufacture of the 111 will be spread within BAC's aircraft group. Hunting Aircraft will build the wing; aft section will be completed by Bristol Aircraft, and fuselage and final assembly will be done by Vickers-Armstrongs at its Hurn plant near Bournemouth. The BAC team now is working on a follow-on study of stage lengths past the 1,000-mi. mark.

The BAC 111 is 93 ft. 8 in. long, with a wingspan of 88 ft. 6 in. and a wing area of 980 sq. ft. Takeoff weight is 66,000 lb. and maximum payload is 14,000 lb. The aircraft carries 18,000 lb. of fuel and has a 500 cu. ft. freight volume. Its Spey engine is a bypass derived from the Rolls-Royce RB.141 and has been running since December, 1960. Specific fuel consumption is 0.776 lb./hr. at 25,000 ft.

BRITISH AIRCRAFT CORP.'S BAC 111 twin-turbofan transport depicted in drawing above will have a maximum capacity of 69 passengers and will cruise at 540 mph.



THREE-VIEW DRAWING shows position of Rolls-Royce Spey RB.163-1 turbofans (9,850 lb. thrust) relative to low wing. Note airsteps in drawing below.

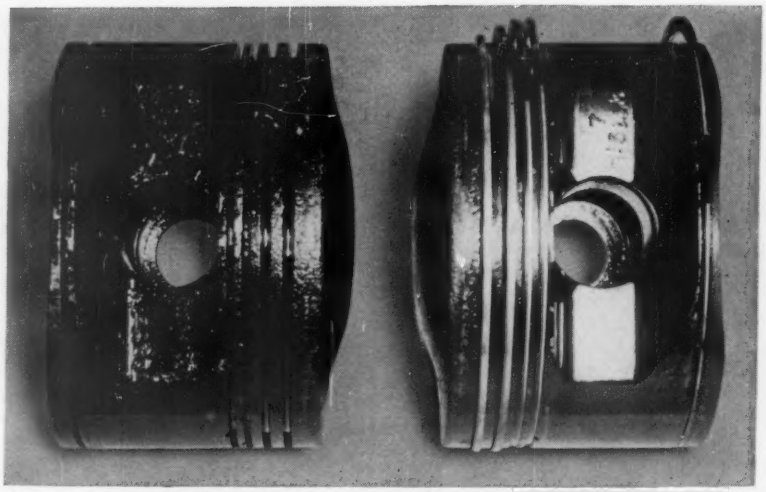


BULLETIN:

AeroShell Oil W becomes first fully compounded additive oil to win approval of every major aircraft piston engine manufacturer in the U.S.

Aircraft, large and small, have logged millions of flight hours on Shell's new additive oil—the first fully compounded additive oil approved by every major U.S. manufacturer of aircraft piston engines.

Here are answers to 10 key questions about AeroShell® Oil W —how it helps keep engines cleaner, reduces wear—even extends periods between engine overhauls.



Left: Piston from engine using straight mineral oil after 1,000 hours; note sludge and coke. *Right:* Piston from same aircraft after 1,000 hours on AeroShell Oil W.

1. What types of aircraft can use AeroShell Oil W? Piston engine planes of any size. Helicopters, too.

2. Why is it called a non-ash dispersant oil? Because it contains special metal-free additives that help keep tiny, ingested particles in the oil from clumping together and forming deposits. These particles remain suspended and dispersed.

3. How does this affect engine performance? It means that engine parts stay cleaner. That lubrication points get all the oil they need. *Your engine can run more efficiently, parts can last longer.*

4. What about oil consumption? Because AeroShell Oil W helps provide a cleaner engine and less wear, you can expect less oil consumption.

5. Can AeroShell Oil W reduce maintenance costs? If you have been using a straight mineral oil, AeroShell Oil W can reduce your maintenance costs substantially. Intervals between engine overhauls can be extended.

6. How does this new oil respond from a cold start? AeroShell Oil W has an unusually high viscosity index. This guards against excessive thickening of the oil when cold, yet provides proper lubrication when hot. Result: *easier starting, faster warm-up.*

7. Is AeroShell Oil W thoroughly proved? Thoroughly. It's had millions of engine hours of flight time.

8. Can AeroShell Oil W be added as a make-up oil? Yes. It is compatible with all piston engine oils now being used.

9. Is there more than one viscosity grade? AeroShell Oil W is available in *three* viscosity grades: 100 and 120 grades for large engines. And 80 grade for small engines where straight mineral oil grade 55, 65, or 80 is normally recommended.

10. Where is it available? At Shell Aviation Dealers everywhere. *Any* dealer will stock AeroShell Oil W if you ask him.

Technical bulletin on AeroShell Oil W will be sent at your request. Write: Shell Oil Company, 50 West 50th St., New York 20, N. Y.

SHELL

A BULLETIN FROM SHELL
—where 1,997 scientists are helping to provide better products for industry

Consolidations May Follow Varig Purchase

By Glenn Garrison

New York—Purchase by Varig Airlines of 50% of the voting stock in Aerovias Brasilia may be a step toward the consolidation of Brazil's three international carriers within a year or two, according to Varig president Reuben M. Berta.

The purchase, still to be approved by the government, involves establishment by Varig and Real-Aerovias of a board of directors and a new president to control Aerovias. The latter airline now is Real's international division, with routes from Brazil to Miami, to Los Angeles and to Tokyo. Varig operates between New York, Rio and Buenos Aires and from New York to the Caribbean and Brazil.

Third international airline is Panair do Brasil, in which Pan American holds controlling interest. Panair flies to Europe and the Middle East. Berta denied to AVIATION WEEK reports that Varig interests are negotiating to buy majority control of Panair from Pan Am. He predicted that the Brazilian government would handle any such transaction.

"Varig does not intend to pay the bill" for buying Panair control, Berta said. But he forecast that there would be a single Brazilian flag carrier within one or two years.

The Varig-Real agreement is expected to receive government sanction without delay because Brazil's new president, Janio Quadros, was instrumental in bringing about a consolidation. Quadros has expressed the objective of consolidating the international carriers as a move in tightening up the country's economy and avoiding duplication of expenditures for aircraft and equipment.

According to Berta, it is also Quadros' intention to make Panair a Brazilian controled carrier.

Varig now operates three Boeing 707-420s and two Caravelles; Panair has two Douglas DC-8s, and three Convair 990s are scheduled for delivery to Real-Aerovias. Under the agreement, the 990 jets will be assigned to routes of the new jointly controlled Aerovias.

Berta, who pioneered jets in South America with the Caravelles, said the long-range plan is to retire all piston equipment and convert the three airlines to all-jet. Varig's only regret concerning the Caravelle purchase, he said, is that "we don't have enough," and there are tentative plans to buy four more.

Berta acknowledged that there were appearances of some unfavorable aspects to Varig in the agreement. Varig has been making money on its international routes—about $1.3 million last year, according to its president—while Aerovias has been losing money.

But the combined operation can be profitable, Berta said. If properly carried out, it should prove to be a good plan. He noted that President Quadros left the operation entirely to private enterprise, avoiding the possibility of nationalizing the Brazilian international air service.

The "unified command" under the agreement also should mean a favorable development in domestic operation, according to Berta. This would be accomplished by reducing inefficient competition on domestic routes by more agreements among the carriers.

Under the presently proposed agreement, one Varig man and one Real man will be named to the new board of directors, and a neutral president chosen, a man from neither airline.

Actually Varig and Real are buying 45% each of Aerovias stock, the other 10% being non-voting or preferred stock.

Price of the purchase has been reported at about $2.2 million, but Berta would not comment upon the accuracy of that figure. Some sources set the price higher.

Delivery of the 990s is expected next January. They are destined for the Aerovias route to Los Angeles and Tokyo, now being served by Lockheed 1049H Constellations. The 1049Hs, however, probably will be withdrawn in the meantime and replaced with leased Douglas DC-6Bs, reportedly as more economic for the service than the turbo-compound 1049H.

Route Revisions

Regarding Aerovias' route to Miami, plans call for seeking some revisions. Instead of serving Miami via the east coast of South America, Aerovias would try for a west coast route. Varig serves the east coast, and the change would fit more "into the scheme of things," Berta said.

Aerovias had been seeking a Rio-New York route, but Quadros canceled the airline's concession for the route. It would have meant direct competition between Aerovias and Varig.

Aerovias is trying to sell its four 1049H Constellations. Eventually, plans would be to retire Varig's five Super G Constellations and Panair's four DC-7Cs and go to all-jet.

Berta sees a probable fleet of Caravelles for short hauls and Boeings, DC-8s and 990s for the long hauls.

Guest, SAS Accord

Stockholm—Scandinavian Airlines System announced last week that it is withdrawing its financial support from Guest Aerovias de Mexico S. A., which has caused SAS past financial problems, following the reorganization of the Mexican carrier in order to find additional capital and obtain turbine equipment to compete over its critical mid-Atlantic route to Europe.

The SAS announcement said its financial obligations to Guest, including loans, equipment support and aid on the technical and administrative levels, "have been terminated."

The Scandinavian carrier, however, will remain as general sales agent for Guest in most parts of the world, continue to supply some relatively low-level technical assistance and share in the airlines' profits when and if any are forthcoming. The profit sharing, an SAS spokesman said, "will be based on what we have already put in. . . . It's an arrangement under which we hope we will get some of our money back."

In its recapitalization, Guest will cooperate with another Mexican airline, Mexicana de Aviacion, from which it is leasing de Havilland Comet 4C jet transports for its European flights between Paris and Mexico City via Madrid, Lisbon, Bermuda and Miami. Guest hopes to fly the route with Comet 4Cs on a five-a-week frequency by August.

H. Gunnar Beckman, Swedish consul general, will remain as a member of the board of Guest. New members include financiers Carlos Trouyet, Hernandez Delgado and Eduardo Villasenor and U. S. hotel executive Conrad Hilton.

It's affiliation with Guest has been a steady financial strain upon SAS since 1959 and is one of the major factors behind the Scandinavian carrier's own financial difficulties (AW Mar. 20, p. 34).

Convair 880M Flight Tested at Edwards

Convair 880M jet transport made a brakes-only stop 2,900 ft. after crossing the 50-ft. obstacle point and landed during Convair and FAA tests at Edwards AFB, Calif. At 125,000 lb., stall speed was demonstrated at 97 kt., 10 kt. improved as a result of high lift devices, Convair said.

The landing and takeoff tests recently began as part of the certification program which is expected to result in certification by late July. Other flight tests have been made since Apr. 20.

You decide where and when you want to go. The Lockheed JetStar, world's fastest business plane, takes you there with jetliner speed, comfort and reliability. Because it operates from fields of less than 5,000 feet, it can fly direct to hundreds more airports than the big jets—and make better point-to-point time. Four Pratt & Whitney Aircraft JT-12 turbojet engines power the JetStar. Each weighs but 436 pounds yet develops 3,000 pounds thrust. This high thrust-to-weight ratio contributes to the JetStar's short field take-off, its jet-performance climb, and its cruise speed of 500 to 550 miles per hour at up to 45,000 feet. The JT-12's simple, rugged design ensures high reliability and easy maintenance. And it is backed by Pratt & Whitney Aircraft's worldwide service.

Pratt & Whitney Aircraft

Division of **UNITED AIRCRAFT CORPORATION**

EAST HARTFORD, CONNECTICUT

Short Designs Swing Nose SC.5 Freighter

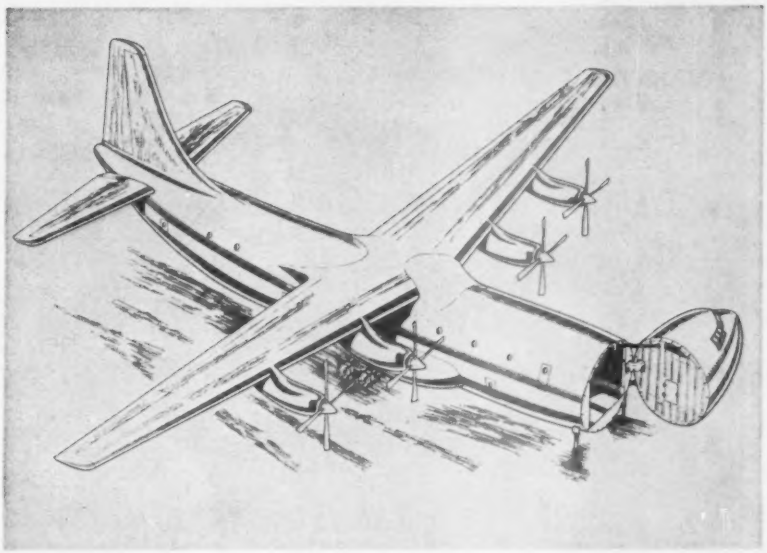
London—Short Brothers & Harland has designed a swing-nose civil version of the Short SC.5 turboprop freighter and hopes, on the basis of studies, to sell it for transatlantic hauls of mixed passengers and freight.

The SC.5 Belfast currently is being built for Royal Air Force, which has ordered 10. First flight will be early in 1962.

H. G. Conway, Short Brothers' deputy managing director, said here that the civil version, a double-decker, is aimed at hauling up to 100,000 lb. of payload nonstop between New York and London.

He added:

"It seems possible to offer a one-way passage across the North Atlantic for as little as $70, while carrying 55,000 lb. of freight." Conway maintained that conversion of the upper floor from all-cargo to all-passenger can be done in under 1 hr.



DRAWING of Short SC.5 Belfast civil version of the RAF turboprop freighter shows hinge point for swinging nose well behind flight deck. Note supporting jacks.

Swing Nose

Dominant feature of the new configuration is the swing-nose, which breaks away from the fuselage well behind the flight deck. Two jacks support the aircraft when the nose is open. Powerplants would be Rolls-Royce Tynes.

In designing the double-deck version, Short Brothers has provided three rollerways onto which cargo pallets can be loaded on the lower deck. Optimum height of a load, whether on a pallet or inside a container, was estimated to be about 6 ft. to reduce loading complications.

By keeping pallet height to 6 ft., Short Brothers can build an airplane to haul the 55,000 lb. of cargo, while providing room on the upper deck for 138 passengers. If a full cargo load was carried, total weight would be about 60,000 lb. on the lower deck, and an additional 40,000 lb. on the upper deck.

The company decided on a swing-nose, against rear-loading, to save time; an idea for a rear door and ramp was eliminated for a marked saving in structural weight. Passenger version allows for side-cavity stowage of baggage, with larger pieces being transported as freight.

Subject to Change

Short Brothers has emphasized that the follow-on to the SC.5 is a design study and that no orders have been placed as yet.

Configuration could be subject to change on the basis of individual airline needs.

However, to spur interest in the civil SC.5, the company also has designed a cargo terminal for a North Atlantic operation, in which containers would be prepacked at a factory or made up at the terminal and loaded aboard the airplane by means of trolleys.

For unloading, the SC.5 would taxi to a predetermined ramp, open its nose and discharge the cargo onto one trolley, which is then shunted aside, and another trolley moved to the nose section for reloading the fuselage.

Conway estimated that the entire operation could be completed in about 30 min.

New Approach Urged On Service Problems

Washington—Civil Aeronautics Board is urging communities and airlines to try to settle adequacy-of-service problems among themselves before bringing long, costly investigations before the board.

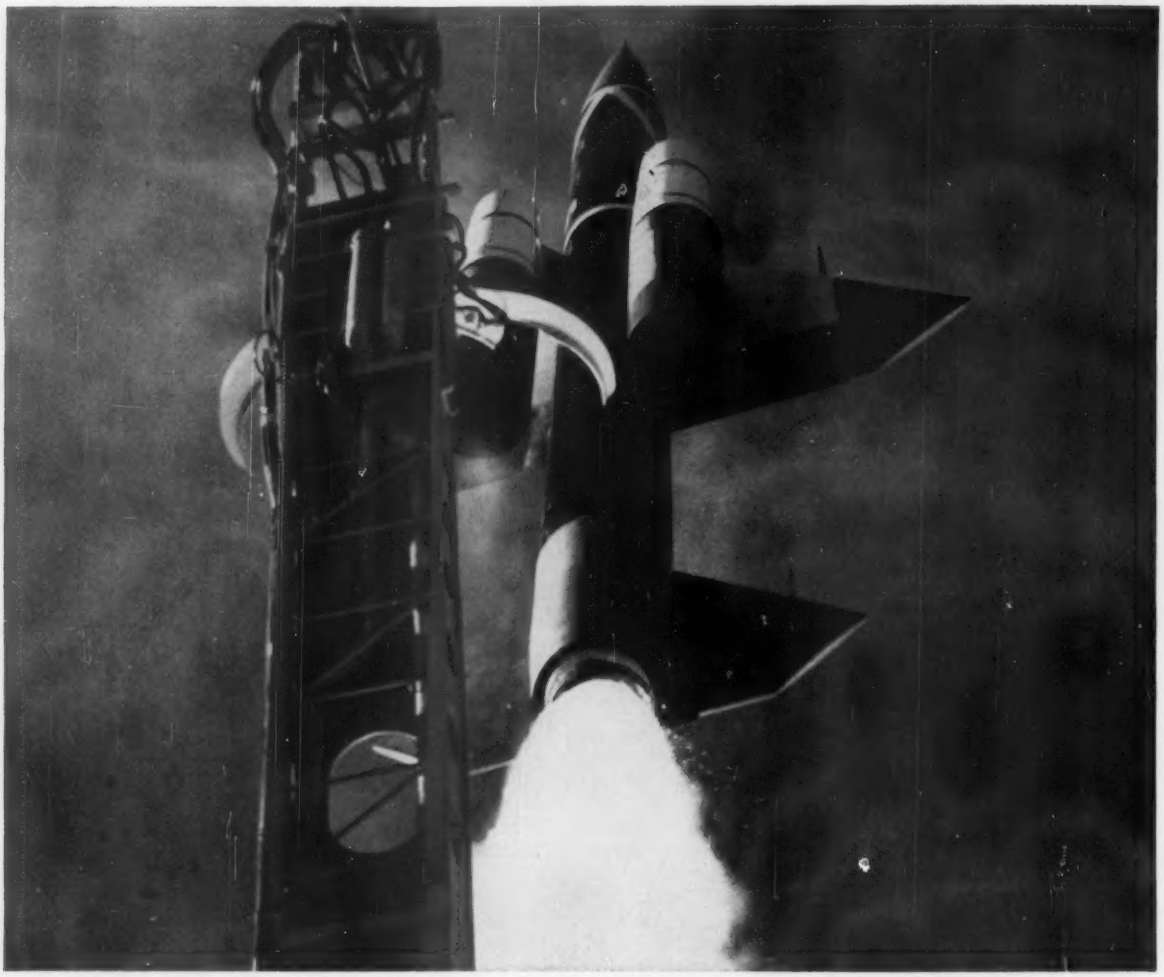
In a letter to airlines, state and local governments and civic organizations, the Board has outlined its new approach to settlement of adequacy-of-service problems and indicated the role of its newly created Office of Community Relations in the field. The Board urges communities and airlines to settle service problems among themselves. Should that fail, CAB offers the services of its Office of Community Relations to handle the difficulties.

This office—created last March during the reorganization of the Board by Chairman Alan S. Boyd—is headed by former chief of the Routes Division John W. Dregge. Dregge hopes he can resolve adequacy-of-service controversies before they reach the Board in a formal investigation by promoting mutual understanding of airline problems and community desires for more service within the framework of the Federal Aviation Act. Dregge sees his role in the proceedings as a "catalytic agent" rather than a mediator.

The Board and its Office of Community Relations currently are seeking suggestions from airlines and communities to help establish long-range standards to determine how much service a community should receive.

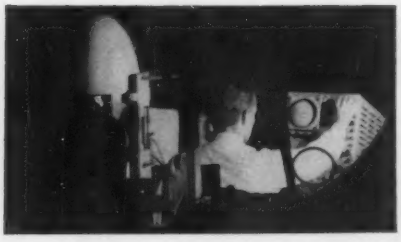
Many present adequacy-of-service problems stem from progress within the airline industry itself. The impact of turbojet aircraft on service to smaller communities has been substantial, with service declining at cities where the traffic cannot support high-capacity jet transports.

Two suggestions the Board feels worth exploring include regional airports—communities could get together within a certain area and decide which of several airports should be used to provide adequate service, or perhaps build an airport better located to serve them all. The second idea involves better connecting services—communities could determine whether their needs could be solved by convenient connecting service from a central airport to a larger airport offering jet service. The connecting service could be provided by a trunkline or a local service carrier, depending on the market.



AUTOMATIC SKY FIGHTER. Supersonic Boeing BOMARC is U.S. Air Force's push-button defense weapon against airborne missiles and attacking bombers. New "B" models have scored test intercepts up to 446 miles from base at altitudes of more than 100,000 feet, establishing new surface-to-air defense missile records for range and altitude. BOMARC A models are now operational at five U.S. Air Defense Command bases. B models will be installed at six bases in the United States and two in Canada.

Capability has many faces at Boeing



WIND SONDE, developed by Boeing subsidiary, Allied Research Associates, will measure wind direction and velocity at wide range of altitudes, telemetering data back for instant use at missile launch ranges, other weather stations.

SPACEMAN'S BLAST-OFF. Boeing Space Medicine researcher prepares for simulated blast-off, wearing belt of Boeing-developed miniature electronic instruments which measure reactions to stresses imposed by take-off of space vehicles.

JET-PROPELLED TEST BOAT, now being built for Boeing, will be used to test experimental surface and subsurface marine vehicle designs at speeds up to 100 knots. Test models will be suspended between two forward hulls. Test boat will supplement Boeing tow-tank research in advancing knowledge in area of hydrodynamics.

BOEING

Airline Traffic—February 1961

	Revenue Passengers	Revenue Passenger Miles (000)	Passenger Load Factor %	U. S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Over-all Revenue Load Factor %
DOMESTIC TRUNK								
American	383,994	300,717	56.9	1,527,418	631,402	6,284,013	37,324,604	52.5
Braniff	172,157	80,094	69.1	445,820	196,755	728,317	9,053,487	49.4
Capital	251,464	114,537	55.7	553,241	259,836	509,151	12,320,469	50.9
Continental	103,771	73,968	53.9	273,728	149,678	623,901	8,138,981	45.6
Delta	291,491	176,013	64.7	658,791	296,572	1,249,879	19,155,326	54.3
Eastern	438,066	243,823	51.4	4,100,077	381,515	1,557,639	29,549,502	46.4
National	97,222	67,637	60.1	260,629	44,380	566,201	7,435,840	46.4
Northeast	120,932	66,479	63.4	159,659	53,874	282,055	6,875,043	51.5
Northwest	7,355	9,184	59.1	71,480	13,665	258,964	1,228,232	55.8
Trans World	238,084	204,008	54.1	1,148,262	547,280	3,097,040	24,395,163	45.7
United	594,457	433,746	62.5	3,911,433	1,122,146	7,631,116	54,331,081	55.1
Western	75,566	42,614	56.1	186,340	65,751	232,206	4,567,516	46.4
INTERNATIONAL								
American	5,659	6,333	71.0	8,317	556	207,281	865,065	60.6
Braniff	7,846	11,834	55.7	39,102	.....	133,669	1,431,824	50.8
Caribbean Atlantic	35,221	2,614	61.8	2,119	.....	7,132	254,478	60.6
Delta	1,379	1,589	41.3	1,261	.....	18,098	193,581	41.4
Eastern	33,565	51,340	59.3	137,913	.....	255,920	5,181,325	57.8
Mackey	11,489	1,949	49.9	.....	201	10,258	202,834	50.6
National[3]	.....	.....	.....	.....	.....	.....	.....	.....
Northwest	7,227	17,144	41.3	1,278,972	1,811	491,316	3,627,571	61.2
Pan American Combined								
Alaska	2,677	2,845	36.2	30,078	1,508	88,362	419,379	37.1
Atlantic	68,430	95,097	45.0	2,044,240	.....	4,111,966	16,170,498	45.2
Latin America	67,423	80,536	63.3	371,272	.....	2,901,309	11,547,348	62.8
Pacific	28,371	109,382	63.1	2,858,191	8,952	2,543,732	16,742,679	57.5
Panagra	9,483	16,349	58.8	87,460	.....	438,675	2,280,106	55.6
Resort[2]	.....	.....	.....	.....	.....	.....	.....	.....
Trans-Caribbean	7,998	13,729	73.5	.....	.....	277,797	954,392	62.4
Trans World	7,860	23,380	37.2	939,297	.....	1,200,428	4,592,296	45.9
United	12,024	29,936	72.4	314,087	6,780	182,704	3,556,798	69.6
Western	2,103	3,270	50.8	7,467	.....	12,983	358,953	47.4
LOCAL SERVICE								
Allegheny	45,616	9,789	39.8	19,049	31,369	48,036	1,032,357	43.0
Bonanza	24,995	6,635	52.1	10,311	3,517	10,660	661,368	53.3
Central	11,886	2,551	38.1	9,211	4,915	13,697	272,610	35.1
Frontier	28,102	8,214	.....	40,080	11,675	59,511	898,387	.....
Lake Central	19,030	2,930	36.1	6,656	15,369	.....	302,559	38.7
Mohawk	48,974	10,027	45.6	21,037	22,089	23,086	1,022,727	43.4
North Central	71,571	13,532	42.8	45,819	51,100	62,583	1,461,440	44.4
Ozark	39,452	7,373	40.0	20,371	22,139	25,644	772,554	43.8
Pacific	33,733	8,114	47.2	14,128	3,751	8,784	800,806	47.3
Piedmont	26,049	5,811	41.6	11,260	10,490	16,321	595,284	42.3
Southern	25,899	4,878	29.3	20,308	10,538	16,509	515,780	30.9
Trans-Texas	21,834	5,069	38.1	21,797	11,135	32,782	551,196	39.7
West Coast	29,109	7,326	43.2	16,174	5,502	13,113	734,444	43.3
HAWAIIAN								
Aloha	23,870	3,672	66.5	2,824	.....	4,956	301,881	55.8
Hawaiian	29,070	5,002	63.5	3,615	.....	269,507	674,471	61.0
CARGO LINES								
AAXICO[2]	.....	.....	.....	.....	.....	.....	.....	.....
Aerovias Sud Americana	.....	.....	.....	.....	.....	209,929	209,929	72.1
Flying Tiger	3,522	16,723	69.2	31,672	32,826	5,735,208	7,472,001	76.1
Riddle—Domestic	.....	.....	....	42,150	33,808	2,813,505	2,889,463	70.5
Overseas	.....	.....	.....	14,757	.....	3,338,993	3,353,750	81.3
Seaboard World	1,235	4,891	100.0	1,382,539	.....	3,537,712	5,419,002	76.3
Slick	2,588	17,668	96.9	.....	.....	2,175,998	3,942,752	91.2
HELICOPTER LINES								
Chicago Helicopter	18,689	312	36.3	991	.....	.....	30,802	30.6
Los Angeles Airways	2,611	96	44.9	4,615	2,105	.....	15,917	52.4
New York Airways	9,038	207	57.7	1,130	750	545	22,234	53.4
ALASKA AIRLINES								
Alaska Airlines	8,208	8,234	56.4	61,468	2,146	292,425	1,200,114	63.1
Alaska Coastal	2,573	284	52.4	3,554	.....	3,842	36,475	63.1
Cordova	1,053	159	37.3	3,673	.....	27,532	47,644	52.8
Ellis	2,452	158	48.0	1,649	.....	1,598	19,400	59.0
Kodiak	524	29	55.3	327	.....	511	4,530	48.3
Northern Consolidated	1,321	421	28.4	48,473	.....	37,201	132,207	54.3
Pacific Northern	7,347	6,546	37.7	174,957	7,964	352,276	1,245,882	55.7
Reeve Aleutian	716	741	33.8	50,474	.....	61,803	193,264	57.8
Western Alaska	387	28	74.0	741	.....	851	4,299	66.0
Wein Alaska	1,465	356	23.5	39,404	.....	47,257	123,360	44.8
Avalon Air Transport	2,404	156	39.3	490	.....	248	15,558	41.3
Samoan[1]	.....	.....	.....	.....	.....	.....	.....	.....

[1] Not available. [2] Operation suspended. [3] National has suspended service to Havana, its only international route.

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

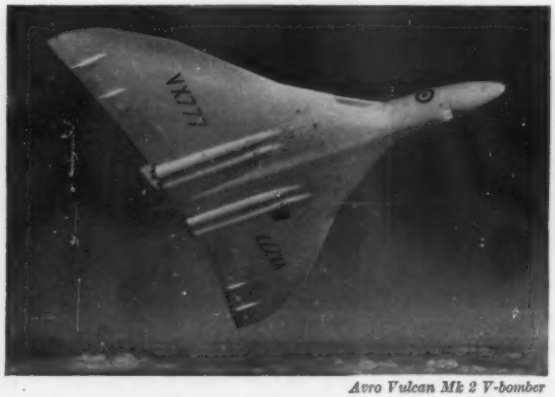
BS
AERO POWER

Olympus—
for supersonic economy at Mach 2 plus

An advanced version of the Bristol Siddeley Olympus is now under intensive development for British Aircraft Corporation's TSR 2. It will give this unique tactical/support reconnaissance aircraft an economic performance at speeds up to Mach 2 and over.

THE RIGHT QUALITIES . . .

The Olympus has the ideal thermodynamic cycle for the economic propulsion of a supersonic aircraft at Mach 2 plus and embodies all the qualities essential for such an application: high power at high altitude; extremely low fuel consumption; great operational flexibility; a long overhaul life; a very high thrust/weight ratio; and excellent handling qualities.

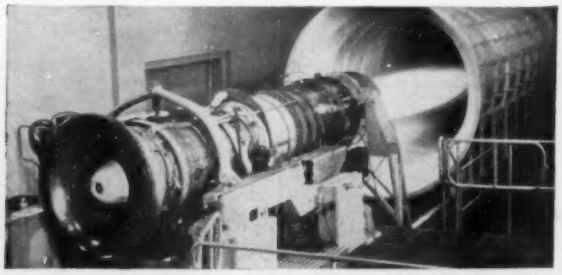


Avro Vulcan Mk 2 V-bomber

. . . PROVED IN SERVICE

The Olympus has proved itself in several years' service, as the powerplant of the Avro Vulcan V-bomber, to be one of the most successful turbojets ever built. Maintenance is exceptionally low—last year, for example, on a 26,000-mile, round-the-world tour, the maintenance required was almost negligible.

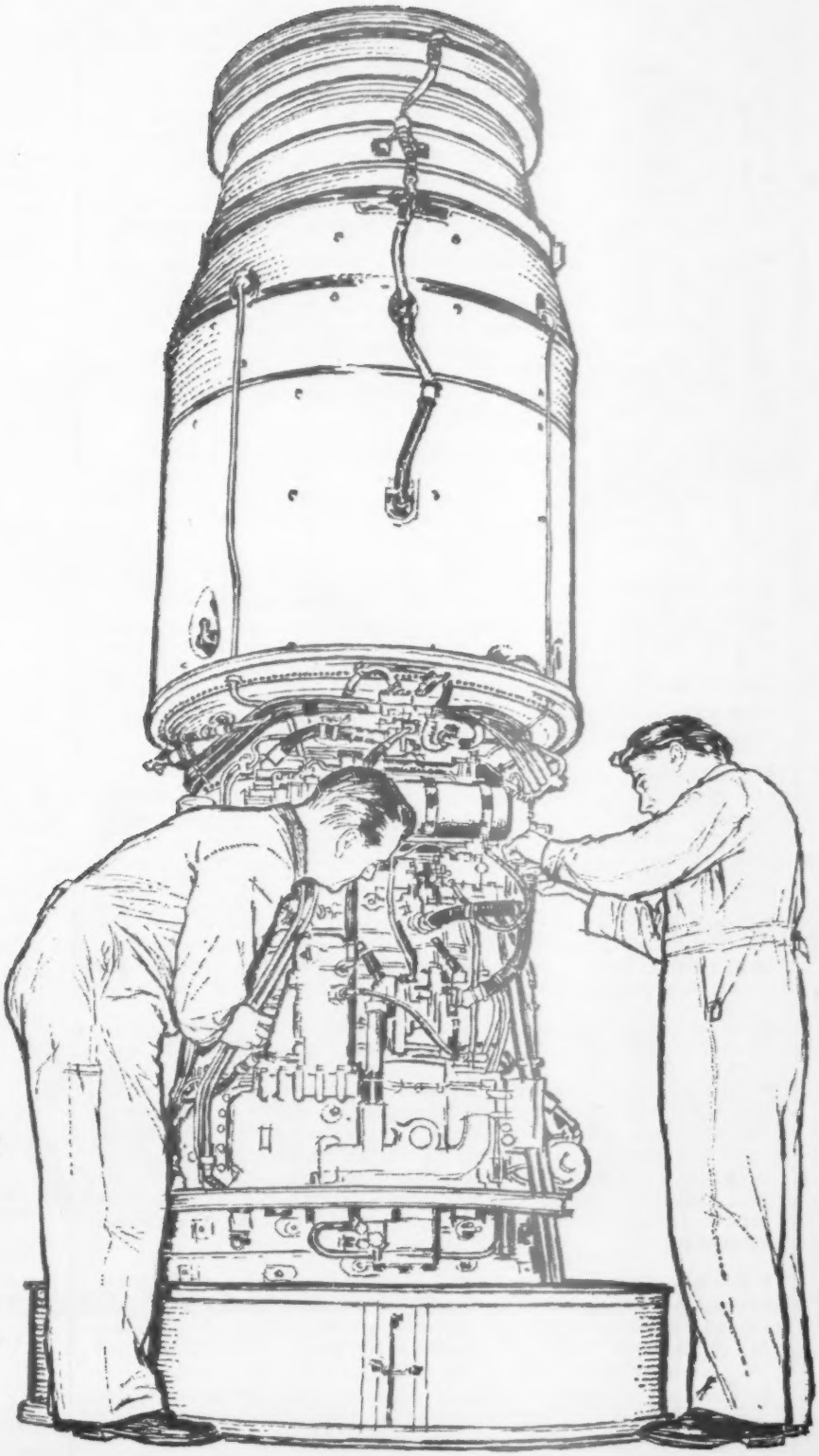
The truly astonishing built-in potential of the Olympus has been confirmed by the threefold increase in power from the 11,000-lb thrust dry of the original production engine, to the 33,000-lb thrust with reheat of the latest version.



Olympus under test with reheat in operation

SUITABILITY FOR SUPERSONIC AIRLINERS

Already selected for the RAF's most up-to-date supersonic aircraft, the Olympus will clearly require only minor changes to adapt it to the requirements of a supersonic airliner in the same speed category.



BRISTOL SIDDELEY ENGINES LIMITED

For further information please write to:
Bristol Aero-Industries Limited,
10210 Pie IX Boulevard, Montreal North, PQ, Canada.

TURBOJETS – TURBOFANS – TURBOPROPS
RAMJETS – ROCKET ENGINES
MARINE AND INDUSTRIAL GAS TURBINES
MARINE, RAIL AND INDUSTRIAL DIESEL ENGINES
PISTON ENGINES
PRECISION ENGINEERING PRODUCTS

AIRLINE OBSERVER

► Opposition to the grant of a Los Angeles route to KLM (AW Apr. 24, p. 38) continued to grow last week as Dutch and U. S. delegates met to resume bilateral agreement talks reopened on President Kennedy's instructions. Air Transport Assn. has been waging an intensive campaign against the proposed route authorization, and the Civil Aeronautics Board opposes the move. State Department, which flatly refused to grant the route last year, has set three basic capacity requirements as conditions for conceding it now. These would require KLM to hold capacity to 1960 schedule levels, restrict Fifth Freedom traffic to 20% of total U. S.-Netherlands traffic and define "stopover" as a 72-hr. period. Passengers traveling beyond Amsterdam, spending less than 72 hr. there, would be considered Fifth Freedom traffic.

► Watch for Trans World Airlines to take a broader view of merger possibilities now that Howard Hughes' control of the airline is temporarily shelved. TWA is likely to examine the entire merger spectrum rather than confine itself to the Northeast Airlines negotiations, where Hughes had interests in both parties. Because of its Florida route, Northeast is still a major prospect, but TWA also is likely to consider others that might give it alternative southern, off-season routes or that might strengthen its international routes.

► Aeroflot's 70-passenger, twin-turbojet Tu-104s will continue to fly Russia's trans-Siberian Moscow-Khabarovsk route despite inauguration of regular nonstop service with Tu-114 turboprop transports late last month (AW May 1, p. 52). Initial trip frequency with the 170-passenger Tu-114 is only twice weekly. Scheduled Moscow-Khabarovsk flying time for the Tu-114 is about 9 hr. Tu-104s make two intermediate stops on the 4,350-mi. route. Trains require seven days, but rail fare is 89 rubles, compared with 119 by air.

► Federal Aviation Agency analysis of air traffic controllers' activity while working busy shifts in the New York Center has indicated that individual controllers spend up to 60% of their time processing routine paper work and up to 25% solving intra-sector coordination problems. More than 1,000 observations per station were collected at 10 sec. intervals during shifts when the number of pilot position reports was twice the average level.

► International Air Transport Assn. and Air Transport Assn. have agreed on a universal interline message format suitable for both manual and machine handling. Format permits reservation messages to move automatically through data processing machines and linked communications systems of airlines without revising messages to conform to standards of a particular airline.

► Federal Aviation Agency, after consultation with Air Transport Assn. and Air Line Pilots Assn., will undertake a study of how pilots allocate their cockpit activity by duty subject. Prime purpose of the study is to establish criteria for automatic flight aids.

► Finnish airline Aero O/Y, Finnair, has begun direct service between Moscow and Helsinki with Sud Caravelle turbojet transports.

► Delta Air Lines will begin its southern transcontinental service June 11 with four round trips daily, using Douglas DC-8, and DC-7 and Convair 880 equipment. One DC-8 flight will operate nonstop between Atlanta and Los Angeles and a second will fly between the two cities with a stop at Dallas. The Convair 880 flight will serve the Atlanta-Los Angeles route with stops at New Orleans and Fort Worth. The DC-7 flight will operate between Jacksonville and San Diego with stops at Orlando, New Orleans and Dallas.

► Domestic trunkline common stocks listed on the New York Stock Exchange were again attracting investor interest last week in a market that generally showed both sharp declines and advances in heavy trading. At mid-week, five of the eleven trunklines listed—Delta, Northwest, United, Capital and Western—reported new highs for the year. National showed a strong gain following a Civil Aeronautics Board order permitting the carrier to sell 400,000 shares of Pan American stock. Pan American stock registered only a slight drop when the Board order was issued.

SHORTLINES

► **American Airlines** reports its 30-min., no reservation aerial sightseeing trips, using Electra II and DC-6 equipment, have proved successful in the New York area. The service was scheduled for introduction in Washington May 13 and in Chicago and Buffalo, May 20.

► **Civil Aeronautics Board** has rejected Eastern Air Lines' plan to identify its Pratt & Whitney JT4 turbojet-powered DC-8s as "DC-8Bs." Eastern had offered to label the designation as strictly its own.

► **Continental Airlines** has asked Civil Aeronautics Board to permit low night coach fares on its Boeing 707 flights beginning June 11 over the Los Angeles-Phoenix-San Antonio-Houston route awarded recently in the Southern Transcontinental Service Case.

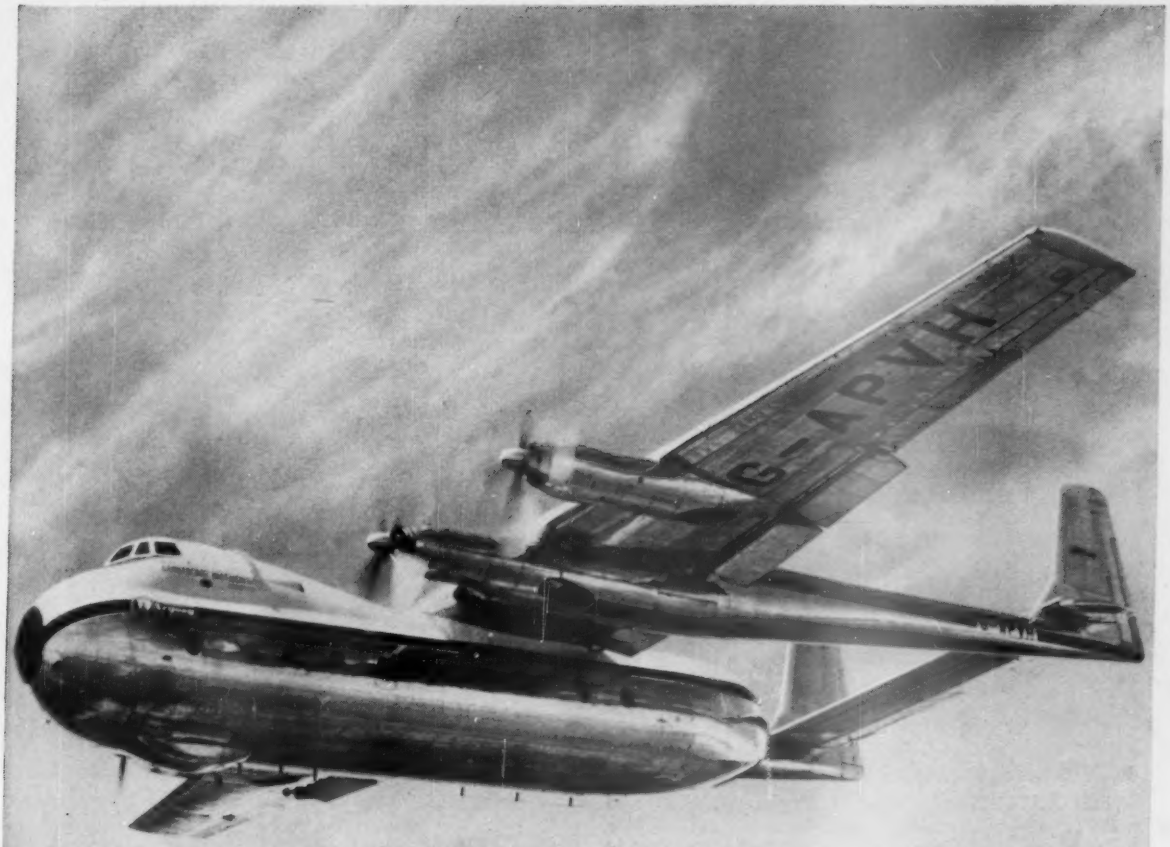
► **Eastern Air Lines** will begin construction of a major jet overhaul base at Miami International Airport about Sept. 30 with funds from a $17.25-million bond issue already approved by the Dade County Port Authority. The bond issue will be paid through Eastern lease fees on the new buildings.

► **Federal Aviation Agency** pilots authorized to rent aircraft for official business will be qualified under new rules in one or more of these four categories: 1-2 place single-engine propeller-driven; 3-5 place single-engine propeller-driven; twin-engine, propeller-driven, fixed-wing carrying less than 12,500 lb., and helicopters. Pilots will receive an Authorization to Rent card listing the permitted categories and will be required to take a proficiency test once a year.

► **International Air Transport Assn.** carriers will require passengers traveling between Japan, Hong Kong, The Philippines, Australia, New Zealand and the Fiji Islands and Hawaii, the continental U. S. and Canada to reconfirm reservations not less than 72 hr. before departure. The new policy is an effort to eliminate no-shows.

► **Pan American World Airways** will spend $3.5 million dollars to promote the Visit U. S. A. program abroad through magazine, mail, poster and local advertising campaigns in 750 of its overseas offices.

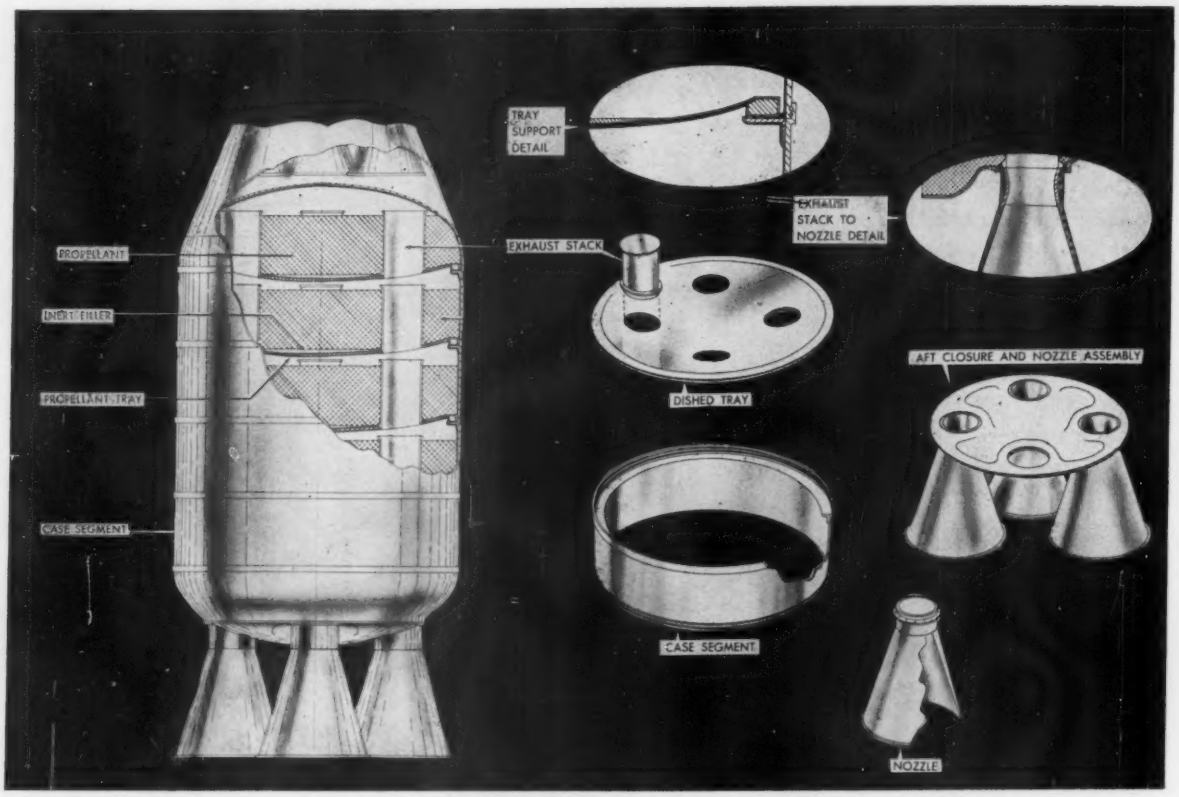
► **TAI,** independent French airline, has begun twice weekly DC-8 service from Los Angeles to Tahiti, using the new 11,200-ft. runway at Papeete's airport. Flights operate via Honolulu on Thursday and nonstop on Friday.



TODAY'S
ECONOMICAL
AIR FREIGHTER

ARGOSY

HAWKER SIDDELEY AVIATION 32 Duke Street, St. James's, London, S.W.1.



DESIGN FEATURES and components for a segmented gel-solid booster engine proposed by Atlantic Research Corp. Viscous propellant would be pumped into holding trays while the launch vehicle is on the pad. The company says a vehicle using this fuel could be ready by 1964. Atlantic Research has fired about 100 small gel-solid engines successfully.

Advanced Solid Booster Concepts Studied

Washington—Industry is continuing to take advantage of the forum provided by the House space committee to propose advanced space booster concepts—largely in the solid propellant field—designed to provide a substantial early increase in U.S. payload capability.

Latest propulsion companies to take advantage of this forum were Atlantic Research Corp., which has developed the technology for a viscous fuel for multi-million pound boosters (AW April 24, p. 31), and Grand Central Rocket Co., which has conducted a launch vehicle development study for a manned lunar landing.

Propulsion hearings began in March (AW Mar. 20, p. 50) and covered a wide spectrum of potential solid, hybrid and nuclear engine theories aimed at surpassing the payload capabilities of the Russians. The hearings are part of the National Aeronautics and Space Administration's Fiscal 1962 budget authorization testimony before the House Committee on Science and Astronautics.

Chairman Overton Brooks (D.-La.) set the stage for Atlantic Research and Grand Central proposals by expressing concern over absence of a backup vehicle for Saturn, and the U.S. failure to take advantage of the potential of large segmented solid boosters.

The Atlantic Research gel-solid concept, which the company hopes to sell both to NASA and the Defense Department, is designed to provide economy, reliability, thrust flexibility and handling ease not available in all-solid or all-liquid systems.

The engine is essentially a series of compartments with a central exhaust stack to the nozzle. Compartments, called trays, support the propellant which has the consistency of toothpaste. A pyrofuse igniter is part of each tray, and all compartments in a stage are ignited simultaneously.

The gas surges against the top of the compartment, which is shaped to direct the flow into the mouth of the segmented exhaust stack.

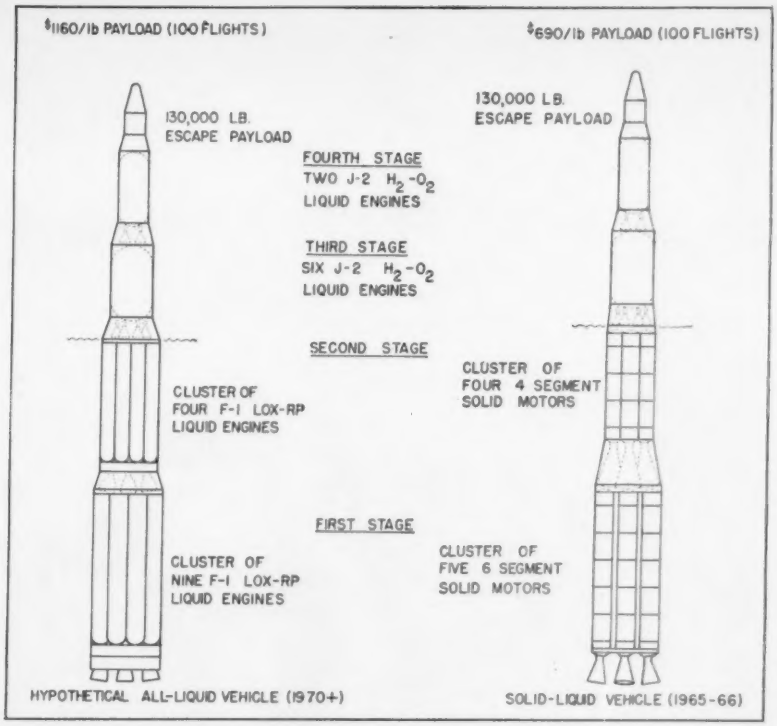
Propellant mass fraction of 0.83 requires a comparatively heavy vehicle to support trays and exhaust stacks. The company maintains that the weight increase is more than compensated by over-all design simplicity and low fuel cost. With a high rate of production, Atlantic Research says the propellant can be delivered to the launch vehicle for 80 cents a pound.

Hardware for the gel-solid booster would be similar to distillation columns used by the chemical industry, with a rubber-based insulation liner to protect the metal parts against heat corrosion. Thrust vector control requirements are similar to those for solid engines, and Atlantic Research favors control by secondary injection of exhaust gas.

Dr. Arch C. Scurlock, Atlantic Research president, sees no advantage to the gel-solid concept for small launch vehicles, but he feels the advantage grows steadily with increase in booster size. The company has made about 100 tests using small motors and claims complete success in ballistic operations.

Detailed engineering studies have been made on these two boosters using the gel-solid concept:

• **Million-pound thrust system,** with a 45-sec. burning time. Motor would have a 10-ft. diameter, gross loaded weight



GRAND CENTRAL ROCKET CO. comparison of cost and timing for all-liquid and liquid-solid manned lunar launch vehicles. Company sees no breakthroughs required to produce vehicle at right in 4-5 yr. One of the four-segment second-stage motors, Grand Central says, could be an alternate for Saturn booster.

of 216,000 lb. and a propellant weight of 182,000 lb. The booster, about 30 ft. high, could be test flown 25 months after the program began, and development would cost $13.5 million, the company says.

• **A 4-million-lb. system,** also with a 45-sec. burning time. Gross weight of the 20-ft. diameter vehicle would be 827,000 lb., of which 686,000 lb. would be propellant. Company feels this vehicle could be flown 30 months after a program was initiated, and development would cost $29.5 million.

Basic advantages of the gel-solid concept center around its low cost and ease of handling, according to Atlantic Research. Production involves grinding and mixing with shipment by tank car. Propellant would be shipped as a Class B explosive, the same as solid rocket engines.

Propellant cracking and liner separation—factors which have plagued solid grain technology—are eliminated in production, shipping, burning, storage and loading, the company says. The pumpable propellant requires no environmental controls for loading, which would be made in an inert vehicle structure. Booster loading would be the final step before launch countdown.

Although storability has not been determined for extended periods, the company believes that the propellant could remain viscous for any time requirement up to several months.

Atlantic Research says the gel-solid is adaptable to segmented design by size and configuration of the holding trays.

The company feels booster supports could be constructed inexpensively by unitized fabrication. The motor case and integral tray supports would be made of air-hardened alloy steel. Propellant trays would be modular sections of steel, and exhaust stacks would be inserted in the trays before installation. The engine aft closure would be a single pressed piece of air-hardened alloy steel.

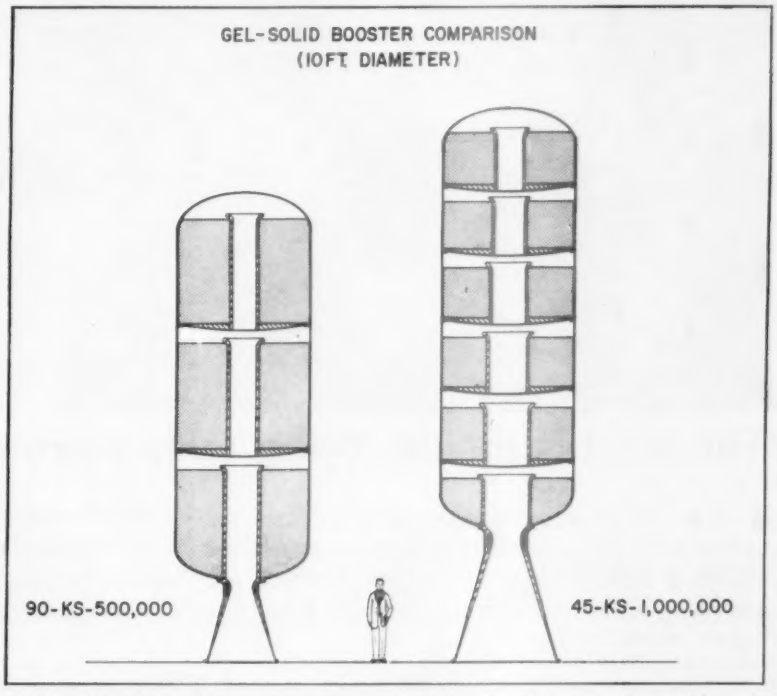
The Grand Central Rocket presentation was pointed toward a concept for a solid-boosted manned lunar landing vehicle with the added virtue of being a backup or substitute for the Saturn.

Dr. Cledo Brunetti, Grand Central president, said NASA should spend a minimum of $50 million on large solid booster development in Fiscal 1962. The agency has requested $3.1 million in this field.

Under committee questioning, Dr. Brunetti said he feels NASA solid rocket programs should be distinct from military programs like Polaris because mission requirements are not comparable.

If authority to move ahead on a large segmented solid booster were received by September, Dr. Brunetti said, the U. S. could have a manned lunar launch vehicle ready for an operational mission by 1965 or 1966. Booster would be a cluster of five six-segment engines, and second stage would be a cluster of four-segment engines.

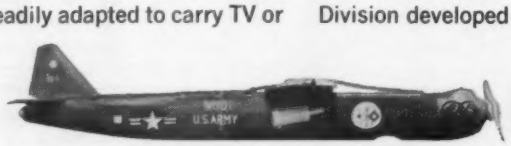
Third stage would be a cluster of six hydrogen-oxygen J-2 liquid hydro-



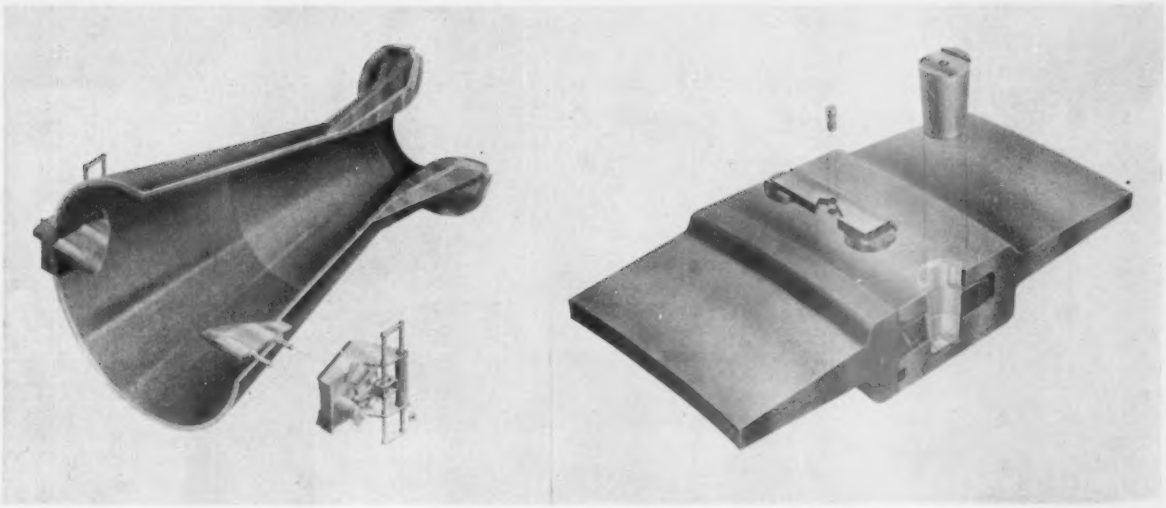
TWO configurations of the Atlantic Research Corp. gel-solid booster, both with a 45 million lb. total impulse. Secondary injection would be used for thrust vector control. Company says a 1 million lb. thrust engine could be developed for flight demonstration for $13.5 million.

The pilot is inside, flying over enemy lines.

The SD-1 Surveillance Drone flies remotely controlled tactical surveillance missions without risking manned aircraft or pilot. It is extremely mobile, simple to use and maintain, and can be readily adapted to carry TV or film cameras, infrared, radiation detection or radar reconnaissance equipment. The SD-1 is the Army's only operational surveillance drone. Northrop's Radioplane Division developed and produces it.



RADIOPLANE
A DIVISION OF
NORTHROP



JET VANE arrangement for thrust vector control in the large segmented solid booster proposed by Grand Central Rocket Co. Company also is studying fluid injection to control thrust vector. Tapered pin joint would be used to connect segments of the solid motor (right).

gen engines, and fourth stage would be a cluster of two J-2s.

Earliest date for an all-liquid booster with a booster stage consisting of the kerosene-oxygen F-1—with a comparable escape mission payload of 130,000 lb.—is after 1970, according to Grand Central. Both vehicles would use J-2 engine arrangements in third and fourth steps.

Company Concept

The company concept, based on studies made for the Air Force and NASA, is centered around two basic motors:

• **Four-segment configuration** with an average thrust of 2.57 million lb., burning time of 70 sec. Motor is 100 ft. long and 13.5 ft. in diameter. A cluster of four of these motors would be the second stage of the launch vehicle for the lunar landing vehicle, and one of the four-motor segments could back up the Saturn.

GEL-SOLID propellant is pumped in a simulated loading operation at the Atlantic Research Corp. plant.

• **Six-segment arrangement,** with an over-all length of 138 ft. and diameter of 13.5 ft. Cluster of five motors with this configuration would be the lunar landing vehicle booster stage.

In addition to compressing time for availability of multi-ton payloads, Dr. Brunetti said, the solid booster has a significant cost advantage over the liquid booster. Cost of developing a vehicle based on the F-1 will total $2 billion through 10 development flights. Comparable development cost of the large solid first two stages would be $1.32 billion.

Grand Central cost studies show a payload-cost of $690 per pound for its proposed solid-liquid manned lunar launch vehicle, and $1,160 per pound for the F-1 based vehicle, assuming the cost is spread over 100 flights.

The solid boosters can be fabricated "by standard manufacturing techniques from standard materials," Dr. Brunetti said.

He added that no breakthroughs are required in metal parts, the rubber-based propellant proposed is a type with which the industry has experience, and nozzle manufacturers can scale up existing nozzles to meet the large engine requirements. He said these manufacturers "will submit fixed price bids" to produce nozzles.

Studies Urged

Dr. Brunetti urged immediate studies of thrust vector control by jet vane or fluid injection, plus studies of case and nozzle materials and fabrication techniques.

He said that with these studies, the design can be frozen in 12-18 months, and will "give assurance that the goal of manned lunar landing will be achieved at the earliest possible time and at the lowest cost."

Randt Cites Manned Space Flight Hazards

New York – Radiation remains the greatest known hazard and weightlessness the greatest unknown hazard in manned space flight, Dr. Clark T. Randt told a meeting of the American Astronautical Society here recently.

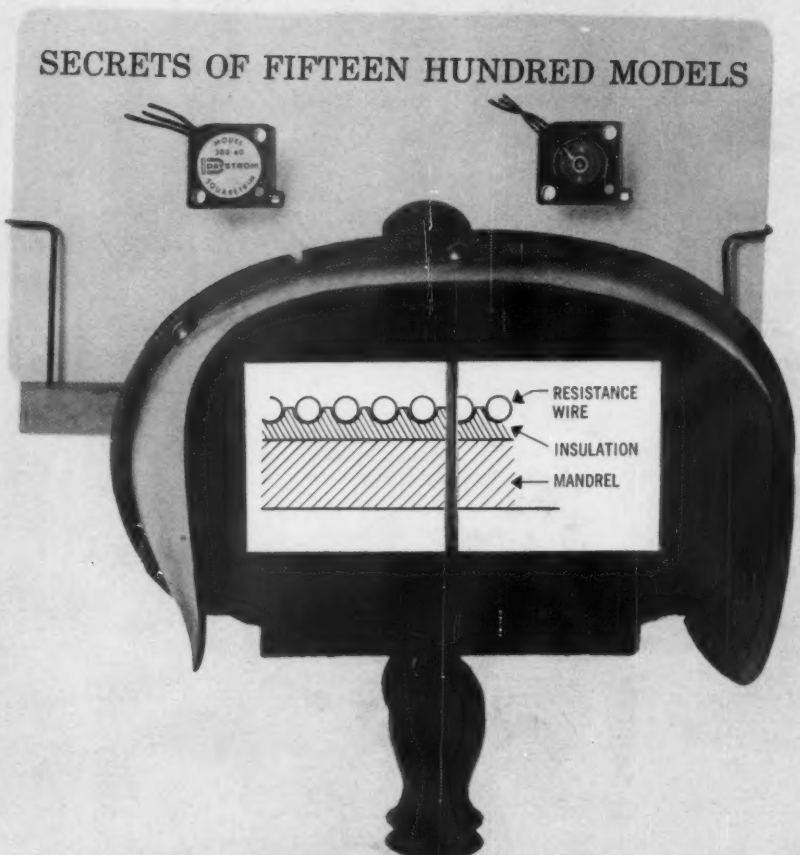
Magnitude of the radiation-hazard problem is on the same order as that of systems reliability, he said. But the advantage is that the radiation problem is fairly well understood. In contrast, little is known about the effects of weightlessness, and no American astronaut has had more than about one minute's exposure to the phenomenon.

Experiments on the sensory systems of cats subjected to simulated weightlessness have shown that a lack of external inputs caused wide swings in the alerting responses of their systems with a marked elevation in blood pressure. The cats had hearing organs removed surgically, were blindfolded and submerged in water, while electroencephalograms (EEG) and blood pressure readings monitored the cats' mental and physical activities. After one and one-half to two hours, the EEG showed wild swings in the brain's alerting responses, cycling on and off over time periods that increased as time passed, accompanied by blood pressure rises.

The implication of these experiments, said Randt in his first public appearance since he resigned as director of NASA's Office of Life Sciences, is that activity in the brain stem is a continuing process which is normally modulated and controlled by outside sensory inputs—sight, hearing, touch and others. Lacking these, the internal feedback goes wild and produces the swings in the brain.

This effect could be produced by pro-

SECRETS OF FIFTEEN HUNDRED MODELS



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longed weightlessness, Randt said, and this is certainly one of the major unknowns in the field of manned space flights.

Other points made by Randt in his presentation:

• **Cost of the Mercury project** is not justified on a basis of the return of scientific information alone, but on the fact that this work must be done as a necessary first step in manned space flight.

• **Most valuable result of Mercury** so far has been the accomplishment of complex performance by chimpanzees. As test animals, they surpass rhesus monkeys by a large factor, and are much higher on the life scale than the dogs which have been used by the Russians as an extension of their Pavlovian experimentation.

• **First major contribution** to manned space flight was made by the Russians with Sputnik 2, which proved that animal life could survive in the hostile environment of space. It is not yet known just how long Laika, the test dog, lived in orbit, but indications are that the time period was perhaps two or three days.

• **Manned space flight benefits** on earthbound medical problems are expected to be substantial in many fields. Advances in medical instrumentation, understanding of the nervous system and brain functions, and increased knowledge of biological functioning are expected to be in the beneficial "fallout" from the programs.

Vought Building Small Space Recon System

Dallas, Tex.—A space reconnaissance system, light and small enough to be carried by a Scout-class rocket vehicle and capable of taking detailed, high resolution photographs even at low light levels, storing the images and transmitting them to earth on command, is undergoing development here by Chance Vought Corp.'s Astronautics Division under a contract from Bureau of Naval Weapons.

Called Istar (Image Storage Translation and Reproduction), it is neither a television nor facsimile system, but is based on an entirely new concept, according to its inventor, C. L. Buddecke, who also is division astrionics engineer. A test version of Istar has been built and demonstrated potential capabilities, according to Chance Vought, and the Navy contract, for more than $250,000, is for development of an advanced version for evaluation. It has applications for reconnaissance in the earth's atmosphere as well as space, according to Buddecke, and is highly resistant to radiation damage from such phenomena as the Van Allen belt.

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X-RAY of the hand of Capt. Charles L. Wilson after exposure for seven minutes to ⅓ atmosphere shows swelling to almost double normal size. In a series of experiments to determine the effects on tissues exposed to low pressures, Dr. Wilson found the swelling is reduced immediately on recompression. Swelling is caused by carbon dioxide and vaporized water.

Tests Show That Exposed Skin Swells in High Altitude Operations

Chicago—Capt. Charles L. Wilson of Wright Air Development Division reported at the recent 32nd meeting of the Aerospace Medical Assn., on a series of experiments which show carbon dioxide gas in combination with water vapor causes swelling of unprotected skin tissue in high altitude operations. Swelling, which frequently doubled the size of the test subjects' hands, was observed in tests of 30 individuals.

Dr. Wilson told AVIATION WEEK that experiments show a distinct chance of tissue reaction from faulty or badly fitted pressure suits, while escape capsules give the greatest protection.

Capsule now undergoing qualification tests was described by James F. Hegenwald, Jr., North American Aviation project engineer on the B-70 encapsulated escape seat.

North American sees potential use of the seat in re-entry vehicles since it provides pressure and atmosphere protection for a crewman in a shirtsleeve environment.

The North American escape capsule has been tested in 16 airdrops and six sled ejections over a velocity profile from 90 to 2,000 mph. Significance of the system, Hegenwald said, is the ability of the crew to perform without cumbersome clothing.

Whirlpool Corp. described a completely self-contained kitchen for a three-man spacecraft which would provide 126 meals for a 14-day mission. Bacteria retardant called iodophor is used to control danger of food putrefaction.

Containers are sprayed with the chemical after use.

The kitchen console was designed for zero-gravity operation and crewmen would eat solid foods from tubes and consume liquids through nipples.

Lt. Col. David G. Simons, chief of the USAF School of Aerospace Medicine's bioastronautics branch, said the best research tool for monitoring exposure to heavy primary cosmic rays is the high altitude balloon, because rocket flights are too short in duration and emulsions from satellite flights are difficult to analyze because of the large fluxes from the Van Allen belts.

Other studies in radiation included:

- **Eye damage** from radiation dosage can be immediate or delayed, and is usually temporary, according to a study by the School of Aviation Medicine made with rhesus monkeys. Data is still needed to determine whether cataracts will result from dosage in billion electron volt range.
- **Biological effects** of galactic primary cosmic radiation, according to a study made by Dr. Simons, indicate more damage to organization of cells than to the individual cells.
- **Exposure to cold** may reduce the onset of tumors which result from radiation exposure. North American exposed a group of 65 rats to whole body radiation and then exposed part of the group to three-hour periods of zero-degree temperatures. Those exposed to cold had reduced incidence of tumors.
- **Direct experimental** approach is required to assess the relative biological equivalent of heavy primary cosmic rays since laboratory tests using ion linear accelerators cannot give an accurate survival curve because exposure requirements are too long.

Dr. Herman J. Schaefer of the Navy School of Aviation Medicine said extended balloon flights are necessary to determine radiation exposure limits for the "human target in space."

- **Radiation can produce** induced elec-

PROJECT NERV

From the first Nuclear Emulsion Recovery Vehicle (NERV) launch and recovery on September 19, 1960, came these important accomplishments:

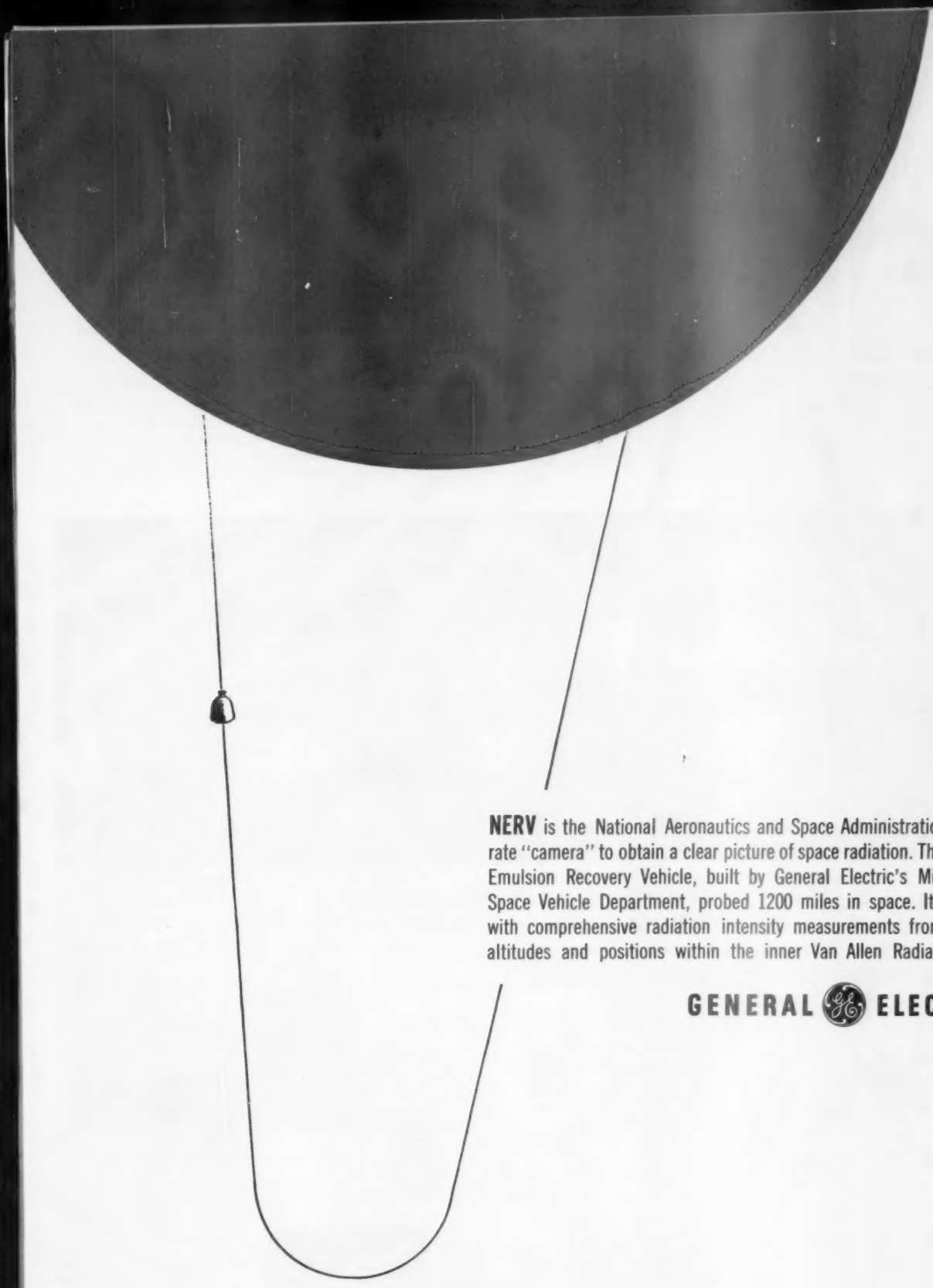
Highest Space Probe of a Recovered Vehicle—The 83.6 lb NERV (19″ wide and 17″ long) was recovered after a 1200 mile-high flight into the inner Van Allen Radiation Belt.

Detailed Measurements of Space Radiation A disc, 1/2″ thick and 3″ wide, extended from the vehicle during flight, exposing a stack of 25 layers of special emulsion to the radiation particles. Recovery permitted scientists to analyze the emulsion directly.

First Re-entry of a Vehicle with a Discontinuous Surface—The NERV ablation nose cone, intentionally discontinuous to permit exposure of the payload, was the first "broken" surface to survive the intense heat of re-entry. Performance of the vehicle was successful in all respects.

General Electric's Missile and Space Vehicle Department designed and built NERV for National Aeronautics and Space Administration's Goddard Space Flight Center. MSVD is a department of the G.E. Defense Electronics Division. 160-04

GENERAL ELECTRIC



NERV is the National Aeronautics and Space Administration's accurate "camera" to obtain a clear picture of space radiation. The Nuclear Emulsion Recovery Vehicle, built by General Electric's Missile and Space Vehicle Department, probed 1200 miles in space. It returned with comprehensive radiation intensity measurements from various altitudes and positions within the inner Van Allen Radiation Belt.

GENERAL ELECTRIC

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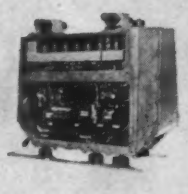
Bendix-Pacific Radar Beacons provide identification, range and azimuth information for radar scope readout. The Rendezvous and Position Indicator Beacons are installed on the B-58; the Position Indicator on the KC-135.



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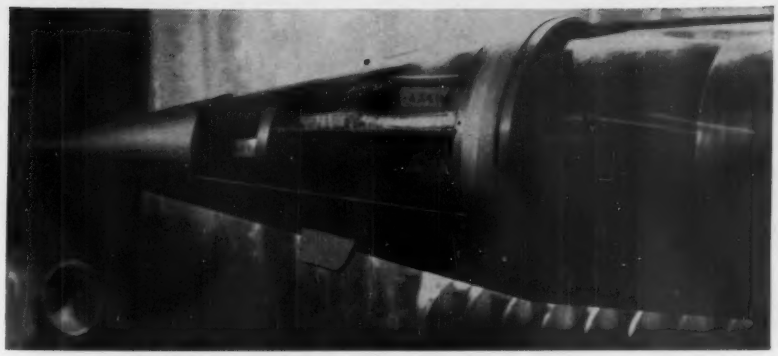


Japanese to Develop Weather Rocket

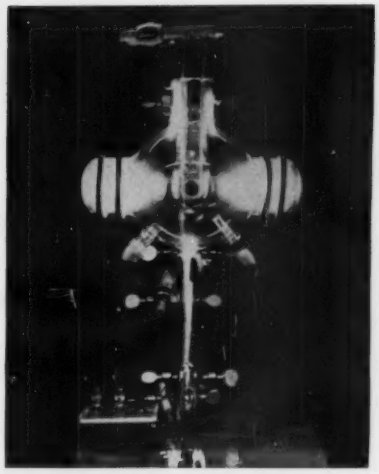
Japanese weather observation rocket (mockup shown) is designed to attain 90-mi. altitude with 44-lb. payload. Motion picture camera in rocket would take pictures at 1/2,000-sec. shutter speed for 200 sec. Japan's Science and Technology Agency budgeted $83,333 to develop and manufacture the 23-ft.-long, 572-lb. liquid-propellant rocket, which would measure atmospheric temperature, wind velocity and wind direction. The Agency expects to launch the first rocket from the southern tip of Kyushu Island in 1962.

trical currents through a space vehicle electrical system, cause ionization and heating of materials, cause atomic displacement or result in transmutation of elements in the vehicle structure, according to a North American Aviation study. Orval H. Minney called for extensive experimentation to establish baseline shielding requirements for electronics and structural systems.

Large number of reports in the bioelectronics field indicate the expanding medical interest in miniaturization of instrumentation and telemetry for manned space missions. Dr. J. L. Riehl of the USAF School of Aviation Medicine has defined a unit of activity related to brain waves which essentially mirror the degree of alertness.

He told AVIATION WEEK that a general baseline can be established and when a crewman falls below normal during a space mission, an instantaneous warning could occur to inform other crewmen or ground monitors of the failure. Deviation from the norm could mean boredom, which would be corrected by a noise, or it could result from oxygen loss, low blood pressure, fatigue or drowsiness.

North American Aviation, and Spacelabs, Inc., are developing a three-channel FM/FM biotransensor which will be permanently implanted in the thoractic cavity of the test subject. The unit is designed for an Atlas launch vehicle test pod and will transmit heart beat, respiration and heart sound data. Rhesus monkey has had the unit surgically implanted for nine months without ill effects.



Plasma Modulation Tube

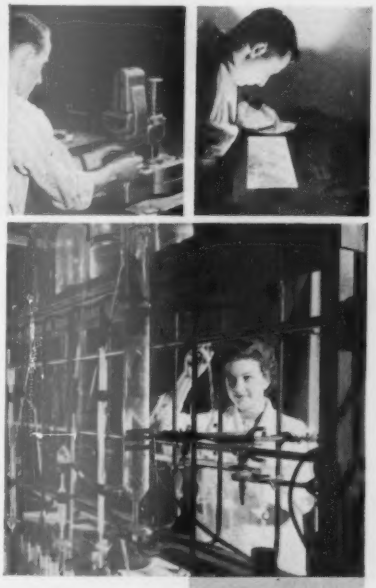
Plasma modulation tube, developed by Melpar for simulating conditions that result in blackout of communications with space vehicles during re-entry. Tube is filled with gases which are ionized by coils attached to two "ears." Center coil coming down through top of tube is used to vary plasma density, while two sets of double probes near bottom measure plasma density and temperature.

Vought to Develop, Make Saturn Fuel Line Elbows

Second Saturn component contract, covering development and fabrication of eight-inch-diameter seamless thin-wall stainless steel fuel line "elbows" for fuel lines, has been awarded Chance Vought Corp.'s Astronautics Division by NASA's George C. Marshall Space Flight Center, Huntsville, Ala.

Elbows will be designed to an ultimate tensile strength of 100,000 psi. Design must be applicable to similar components with diameters up to 17 in., with the possibility of later increase to 32-in. dia. Saturn requires more than 50 of the eight-inch elbows for the first stage cluster of eight engines.

The unceasing vigilance of quality control



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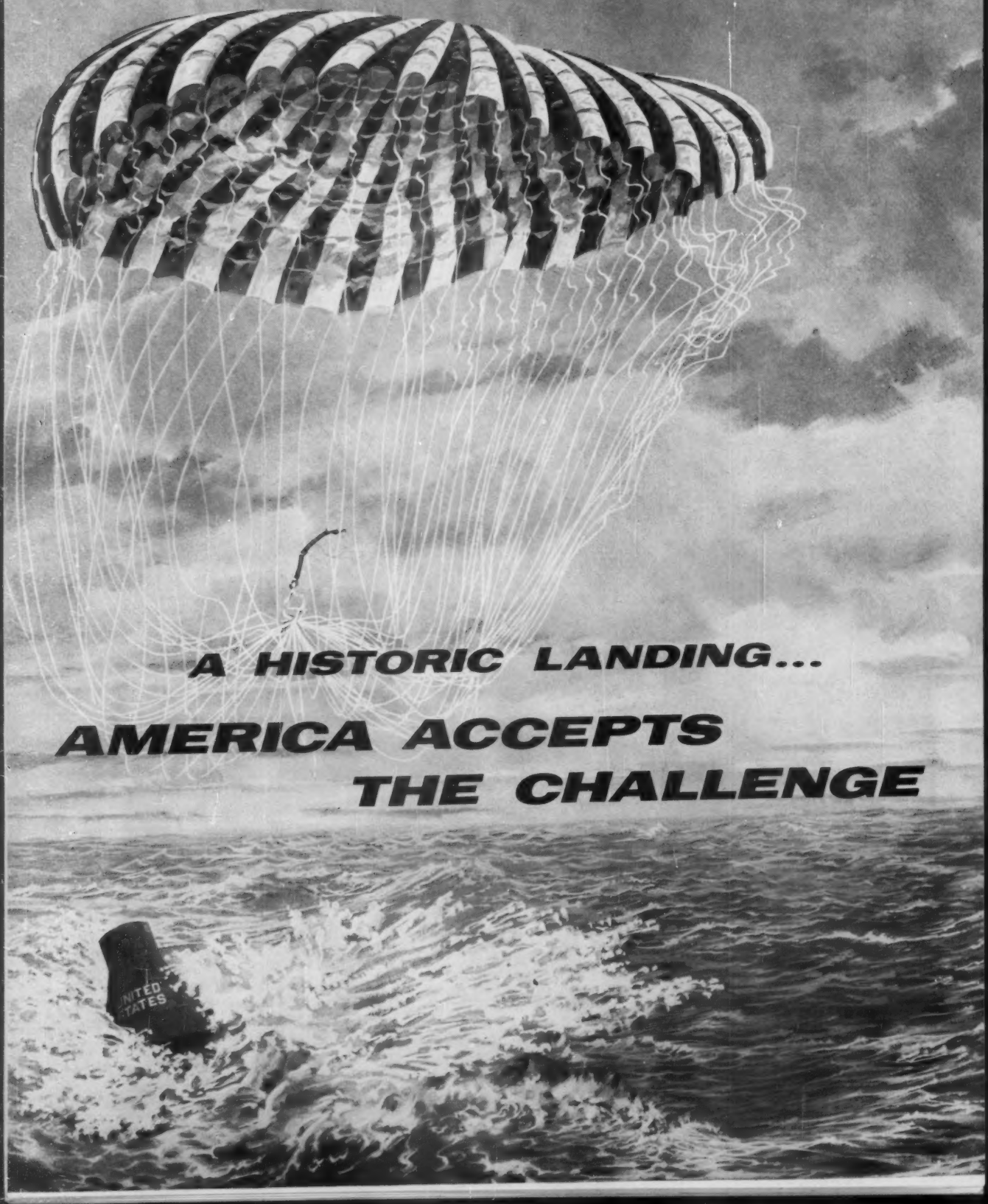


Whisker/Metal Re-entry Material Studied

Palm Springs, Calif.—Composite material, half columbium alloy and half sapphire crystal whiskers, has been shown in hypothetical studies to have four times the strength-to-density ratio of the alloy alone over a temperature range of 3,000F., according to Willard H. Sutton of General Electric Missile and Space Vehicle Department.

Sutton was reporting General Electric investigation of composite materials for space vehicle applications at an American Rocket Society symposium on lifting re-entry vehicles.

Sutton said the data used in his calculations represent neither the poorest case nor the ideal one. Crux of the problem of making composites that include whiskers (filamentary crystals) is to find a method of precisely orienting, wetting and bonding the whiskers in the metal matrix.

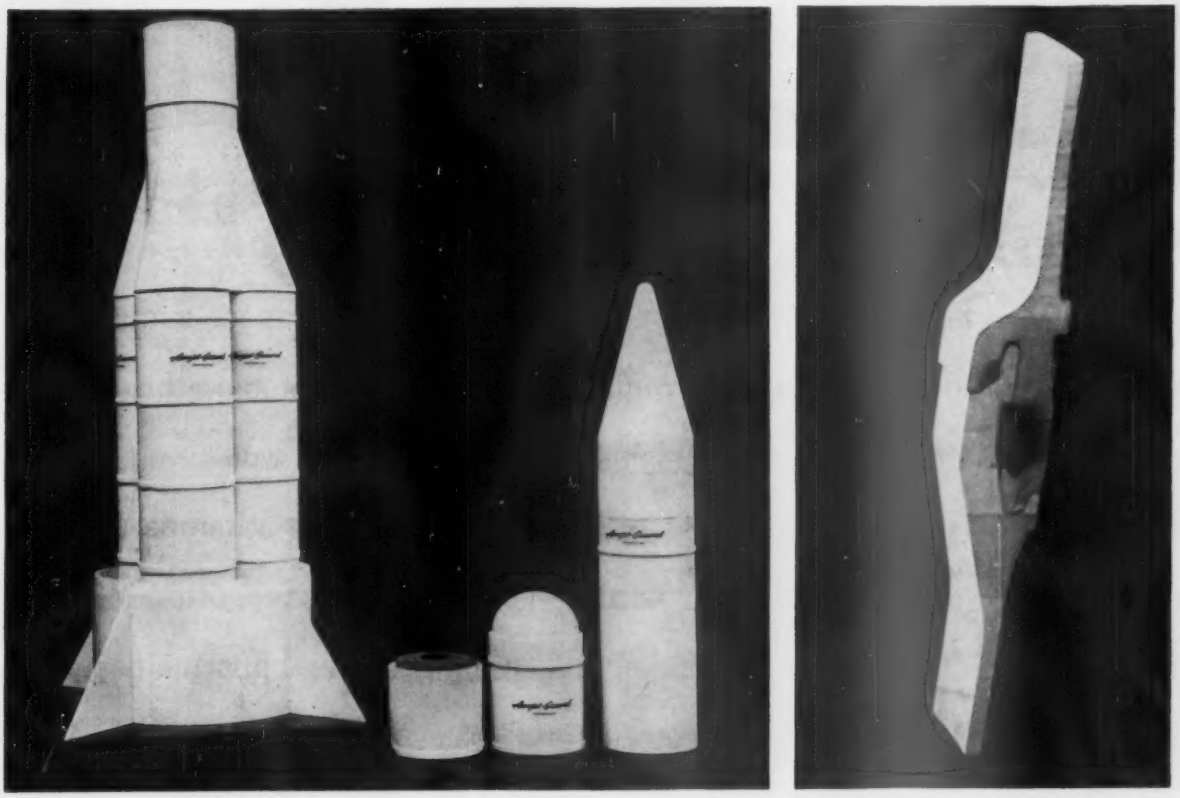
Sutton said, "Several fabrication techniques have been investigated, but vacuum infiltration of fiber bundles with molten metal has received the most attention. For preliminary studies, aluminum and aluminum alloys have been used as matrix phases, primarily because of their relatively low working temperatures. Composites were made of zirconia polycrystalline fibers, glass filaments and sapphire whiskers. Emphasis was placed on studying and improving metallurgical techniques for producing sound composites. Several composites were tested in an Instron Tensile Test machine. In the fabrication of these preliminary composites, the filaments were not precoated to promote bonding. It is evident that they did not pick up their share of the load, although they modified stress-strain relationships considerably. A lithium alloy was used in one case to increase the fluidity of the melt and promote wetting of the fibers. There was an increase in fracture strain which was probably the result of better penetration of the metal into the fiber mass.

"A sample containing 12% whiskers showed a yield stress of 17,500 psi. compared with 10,500 psi. for the unreinforced alloy. Although the fracture occurred at slightly more than 1% strain (the breaking strain of the whiskers) not all of the whiskers ruptured simultaneously, so that the fracture followed in progressive steps."

The General Electric staff has concluded that whisker-metal composites may prove to be a new class of materials with greatly improved high temperature properties and strength-to-density ratios but their successful development depends on the solution of these interrelated problems:

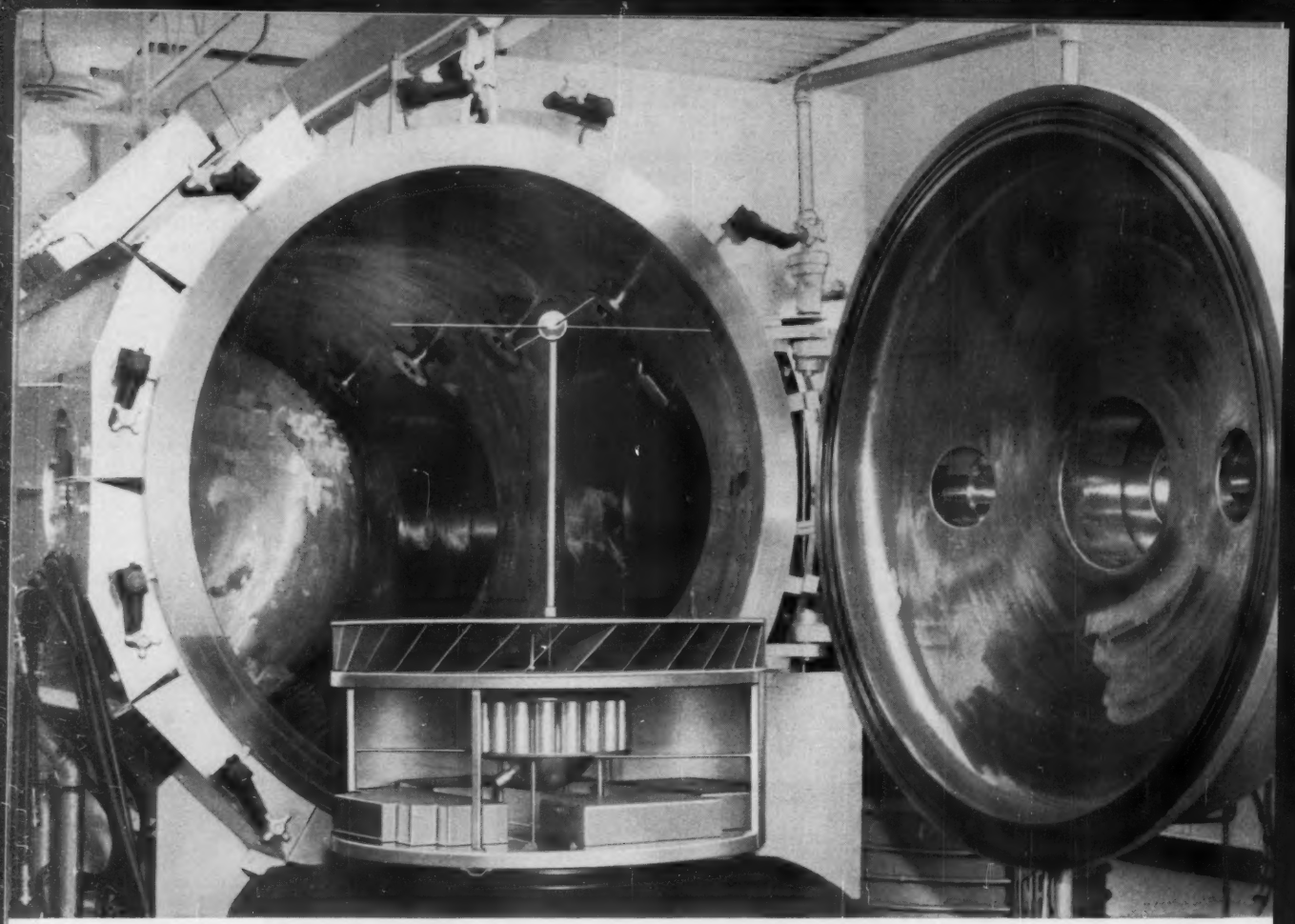
- "Achieving maximum load transfer from the matrix to the fibers through the proper combination and selection of whisker and matrix compositions.
- "Ensuring strong resilient bonding between the fiber and matrix.
- "Utilizing only the strongest whiskers for reinforcement.
- "Fabricating composites such that the whiskers are fully oriented and completely wetted and bonded to the metal."

Sutton said it is too early to verify or modify existing theoretical concepts



333,000-lb.-Thrust Segmented Rocket Motor Proposed

Models of the solid propellant segmented motors proposed to Defense Department, Air Force and NASA by Aerojet-General (AW Apr. 24, p. 87) are at left. Segments include aft closure, minus nozzle; forward head, and center section with payload attached. Motor can develop about 333,000 lb. thrust in 60 sec. burning time. Cutaway model (right) of Aerojet's lock-strip joint and seal, used to join motor segments, shows simulated steel locking band in center and, above it, the rubber O-ring gasket seal. Steel bands are inserted at three apertures in the circumference of the joint and pushed home by air hammer. Time of assembly is less than two minutes, Aerojet reported.



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ANN ARBOR, MICHIGAN

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about composites. Not enough data exists to permit accurate predictions of the strength of metal-fiber composites.

It is assumed that the filaments rather than the metallic matrix carry most of the load in a composite. However, they also may strengthen the matrix by blocking dislocation movements and retarding crack development.

With the filaments all aligned parallel to a tensile load on the matrix, it is assumed that a filament received the load through shear forces at its interface with the matrix. General Electric scientists calculate that shear stresses are greatest at the end of the fiber where plastic deformation of the matrix is most likely. The whisker does not pick up much stress if there is no yielding in the matrix because there is not enough strain in the matrix to stretch the whisker. The matrix need yield only about 16 to 20 filament diameters to transfer the load into the filament. High peak shear stresses near the ends of the whiskers may prove to be the main structural problem in the development of composites.

Chromium Modifications

The ARS meeting also heard David M. Scruggs of Bendix Corp. describe research in which chromium has been modified by the addition of ceramics for use in unprotected structures at temperatures over 2600F. The material has also shown the ability to withstand a heat flux in air of 400 Btu. per sq. ft. per sec. without erosion or structural failure.

Scruggs described the material as "a mixture of electrolitic chromium and an oxide of a Group II metal." It has been named Chrome Cerametalix-30 or Chrome 30, for short. Exposure to air forms a complex, highly refractory oxide coating and does not lower the melt point of the chromium. Tensile strength at 3,000F equals that of Rene 41 at 2,200F. It can be cold worked, hot formed, or machined and is approximately as brittle as recrystallized molybdenum. It has a tensile strength of 1,800 psi. with a reduction in area of 10% at 3,100F.

In general, chromium is not a particularly promising material for re-entry gliders at temperatures above 2,600F while Chrome 30 will withstand an oxidizing environment at temperatures up to 3,800F.

The ceramic content of Chrome 30 apparently increases the strength of the chromium matrix. Ceramic at the grain boundaries enables the material to hold considerable strain, even past the point of recrystallization. Machinability of Chrome 30 is said to be similar to cast iron.

Scruggs believes it possible to acquire Chrome 30 with 30,000 to 40,000 psi. strength within a year.

LONG RANGE INPUT / 1794

News of the recapture of Condé from the Austrians was sped to the French Revolutionary Convention at Paris in a matter of minutes via Claude Chappe's amazing télégraphe aérienne, or relay aerial telegraph, Sept. 1, 1794. A new era in rapid communications had begun.

Today, instantaneous and completely reliable Electronic Communications insure the immediate and continuous interchange of intelligence throughout the Free World. ECI is proud of its initiative and responsibilities in the design, development and manufacture of high precision electronic equipment to the critical specifications required in various aerospace and surface roles vital to our National Defense and to scientific achievement. An example is ALRI—Airborne Long Range Input—a program where ECI communications and data link equipment fill an integral and essential requirement in linking USAF's advanced early warning system to SAGE—our continental defense network.

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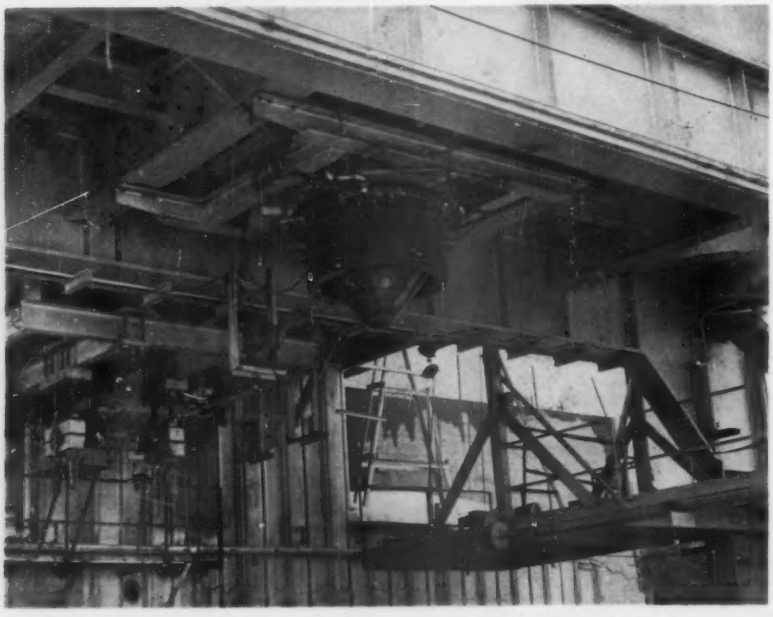
Plug Nozzle Rocket Engine Firing

Liquid bi-propellant plug nozzle rocket engine generating 50,000 lb. thrust has been operated by the General Electric Co. at its Malta Test Station, Saratoga County, N. Y. as part of an investigation sponsored by the National Aeronautics and Space Administration. Plug nozzle concept is said to be the first radical change in rocket engine configurations. Investigation aims at increasing reliability and reducing costs of rocket propulsion systems.



Meteoroid Penetration Of Spaceships Studied

Possibility that intense heat, light and blast would accompany micrometeoroid penetration of a space vehicle and cripple or destroy occupants and equipment is indicated by Chance Vought Astronautics Division tests.

Studies at Chance Vought indicate a definite need for shielding or baffling for space vehicles against possible meteoroid penetration, particularly for those operating in such an environment for prolonged periods. Relatively short flights envisaged in the Mercury or Dyna-Soar programs are not likely to pose as great a hazard.

Chance Vought conducted tests with a simulated space vehicle chamber mounted inside a vacuum tank, during which tiny aluminum pellets weighing about two-tenths of a gram were fired into the chamber at approximately 17,000-mph. velocities. This velocity approaches the speed of slower micrometeoroids; average speed of such a particle is estimated as high as 150,000 mph.

• **Bright explosion-like flashes** were camera-recorded inside the test chamber each time it was penetrated by the pellets, and traces of aluminum oxide, such as would result from an explosion of aluminum, were also found inside the chamber.

• **Tests with rats** indicated definite potential hazards to man in such an environment. In five of six live-subject tests, the chamber contained normal atmospheric pressure and composition. These animals suffered varying degrees of injuries and burns and appeared to suffer from shock. Four of the five subjects survived the effects of the penetrations. In a sixth trial, with the rat exposed to a 90-95% oxygen environment, penetration resulted in vaporific explosion, killing the subject instantly and totally charring the specimen.

Data available leads to estimates that an average-size space vehicle with 1,000 sq. ft. of surface in a near-earth orbit might be penetrated once in 16 hr. if it had an aluminum skin .07-in. thick and once in 48 hr. at 0.1-in. thick.

Navy Formally Cancels Eagle Missile Development

Navy Department formally canceled its Eagle air-to-air missile development with the Bendix Corp., Ann Arbor, Mich. Approximately $57 million of Eagle funding will be reapplied, with $10 million obligated in Fiscal 1961 and $47 million in Fiscal 1962. The money will be used to meet Navy limited war capability requirements and in accelerating Polaris A-3 missile development.

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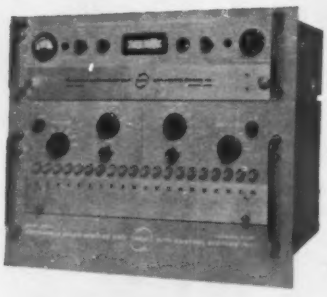

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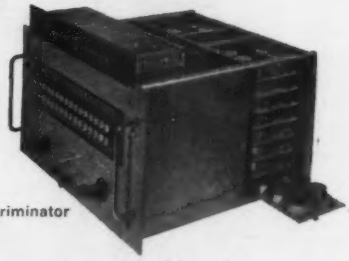

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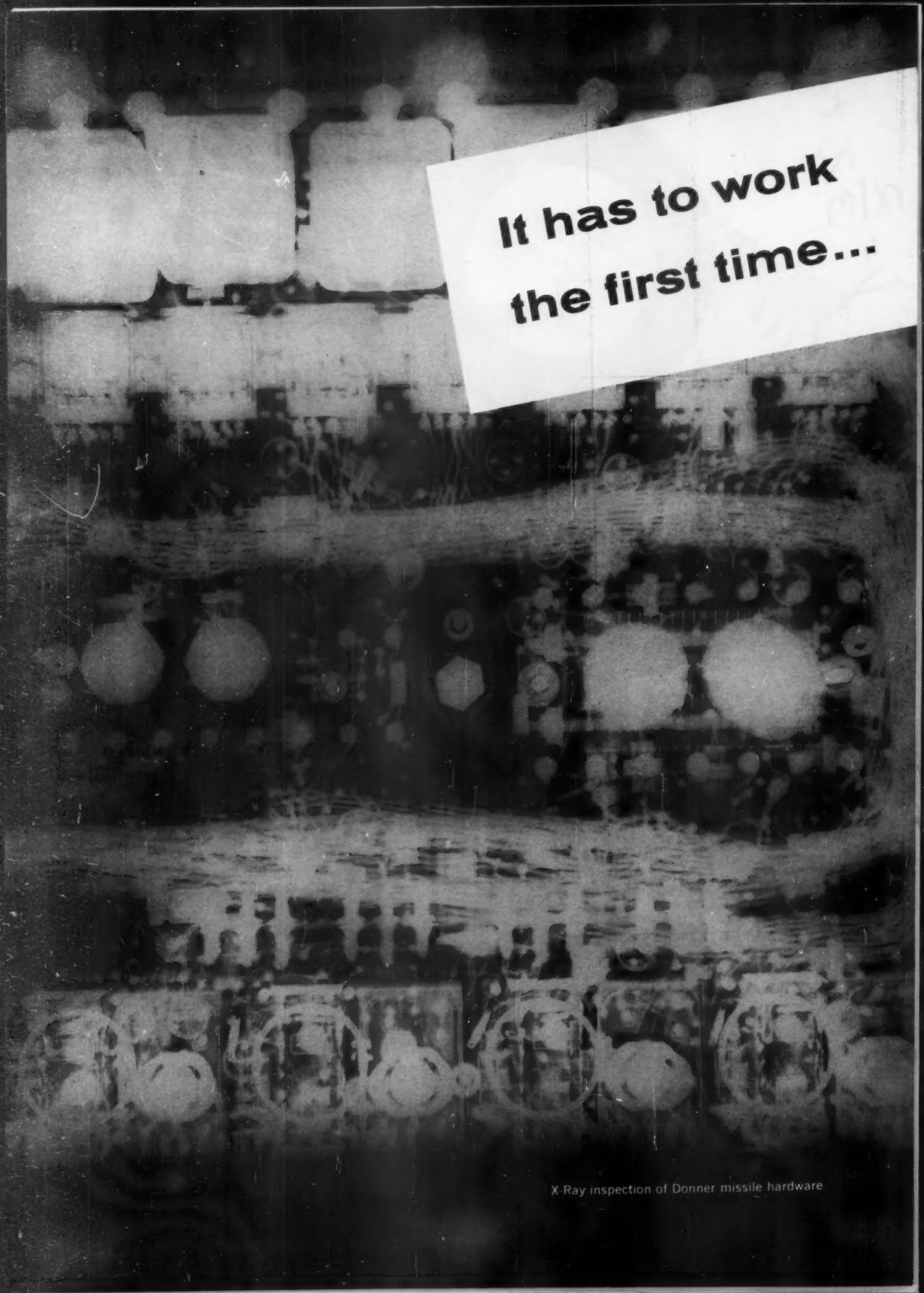

X-Ray inspection of Donner missile hardware

Picture yourself perched in a small capsule atop a large rocket, 90 feet above a Cape Canaveral launching pad. There are thousands of parts in that bird, and in a few seconds they will get the only reliability test that counts...will they work the first time?

To all concerned with that question, we say this: To a large degree, the success of Mercury, as well as every other U.S. space vehicle and missile, will be assured by constant pre-occupation with RELIABILITY. The specialists in this particular field are the Quality Control departments of the many companies who work on these projects.

The X-ray at left illustrates one of Donner's painstaking approaches to reliability. The hardware shown is a unique Donner system for controlling one of America's most advanced and successful missiles. It uses standard Donner accelerometers (lower portion of X-ray) as basic components to detect average missile acceleration. Once this parameter has been determined, the Donner system – actually a miniature computer – monitors flight performance by forcing predetermined phenomena to take place in proper sequence. For instance, if, in the initial portion of the flight the missile has achieved sufficient velocity by a predetermined time, the Donner system allows stage ignition. If correct velocity has not been achieved the system aborts the flight. The missile continues its mission only as programmed.

As in all Donner systems designed to measure, interpret and control flight dynamics, the system at left MUST WORK THE FIRST TIME. To ensure this, Donner enforces rigid quality control. X-ray inspection is one of many routine quality control procedures; it allows inspection of all cabling and components, provides a further check of shielding position, terminations, molding and castings, and detects the presence of any foreign material.

Quality Control In Operation

STANDARDS – Donner's standards are regularly certified by the Western Primary Standards Lab., and by the Navy Standards Lab. located here in Concord. Our participation in the BUWEPS calibration program allows ready access to the most complete facilities available anywhere. Donner's *production testing equipment* includes items frequently used as secondary standards, for example: K-3 Potentiometers and 0.05% differential voltmeters.

ENVIRONMENTAL – Photo above shows part of Donner's Environmental Test Facilities. Included are: vibration test equipment with random excitation consoles; shock tester; centrifuge; temperature, salt spray, humidity and altitude chambers; other general and special purpose test gear.

STATE OF THE ART – Reliability statistics, MIL specs, Gaussian curves and detailed environmental test requirements are no strangers to Donner Scientific. 15% of Donner's total employment is directly associated with the Quality Control function. The ratio reaches 20% on the most demanding projects, such as the system examined by the X-ray.

AS YOU KNOW – There are two facets to reliability: (1) the dependability inherent to the product itself and (2) the absolute assurance that the product under review is the best possible tool for the particular job. Donner Scientific maintains a staff of competent personnel whose primary job is to assist the engineer or scientist in the application of our problem solving tools to his measurement or control projects, using the latest developments in analog and digital technique.

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TRACKING PIONEER V

for 22,500,000 miles, on its way to solar orbit, was aided by Motorola's frontier capability in solid state microwave technology. Compact, ferrite UHF isolators were especially developed to boost tracking receiver performance in order to detect the last faint whisper of available signal strength at this history-making distance.

To listen to a whisper 22.5 million miles away...required Motorola reliability

At ranges approaching this depth in space the conservation of only 0.1 db in signal can add over 200,000 miles of communication. The non-reciprocal properties of ferrite devices were utilized by Motorola to stabilize the gain of parametric amplifiers from changes in antenna impedance. In addition to its advanced solid state contribution, Motorola also was responsible for providing more than 100 cases of high-sensitivity communications equipment on this significant space probe project.

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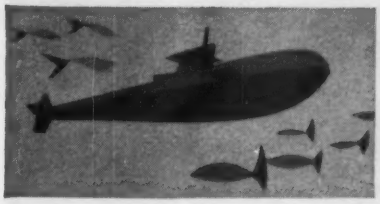

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Vāp-Air Mercs have many uses, widespread acceptance

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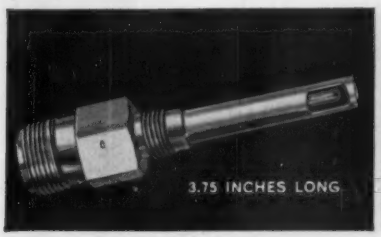
Used for:
Temperature control of electronic compartments, reference ovens, crystal ovens; nose-cone devices; gyroscopes; inertial guidance system; accelerometers; air compressors; turbines; cabins, cockpits, capsules; windshields; de-icing equipment; oil, fuel, hydraulic systems; for telemetering of temperatures; for control systems, and as warning devices in ground support vans and equipment; and many other uses.

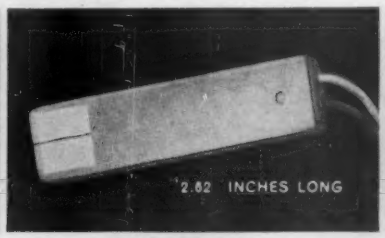
have proved outstandingly accurate and dependable for the most critical thermal sensing and control applications in missiles, aircraft, ground support and undersea equipment.

The Army Ballistic Missile Agency has for two years accepted Merc thermostats as standard temperature control items on all their missiles.

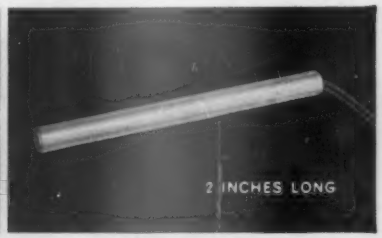
Time after time, Vap-Air mercury tube thermostats have proved their exceptional ability to meet the most exacting specifications for thermal sensing and control. Small, lightweight, they are unaffected by altitude or moisture, can't arc or burn, can withstand 100-G shocks and 30-G vibration without loss of accuracy. They have fast response, close limit tolerances, wide operating ranges, and undeviating accuracy to provide millions of cycles of reliable operation. Mercs need only simple circuits, are adaptable to virtually any need.



DUCT-TYPE



SURFACE-TYPE



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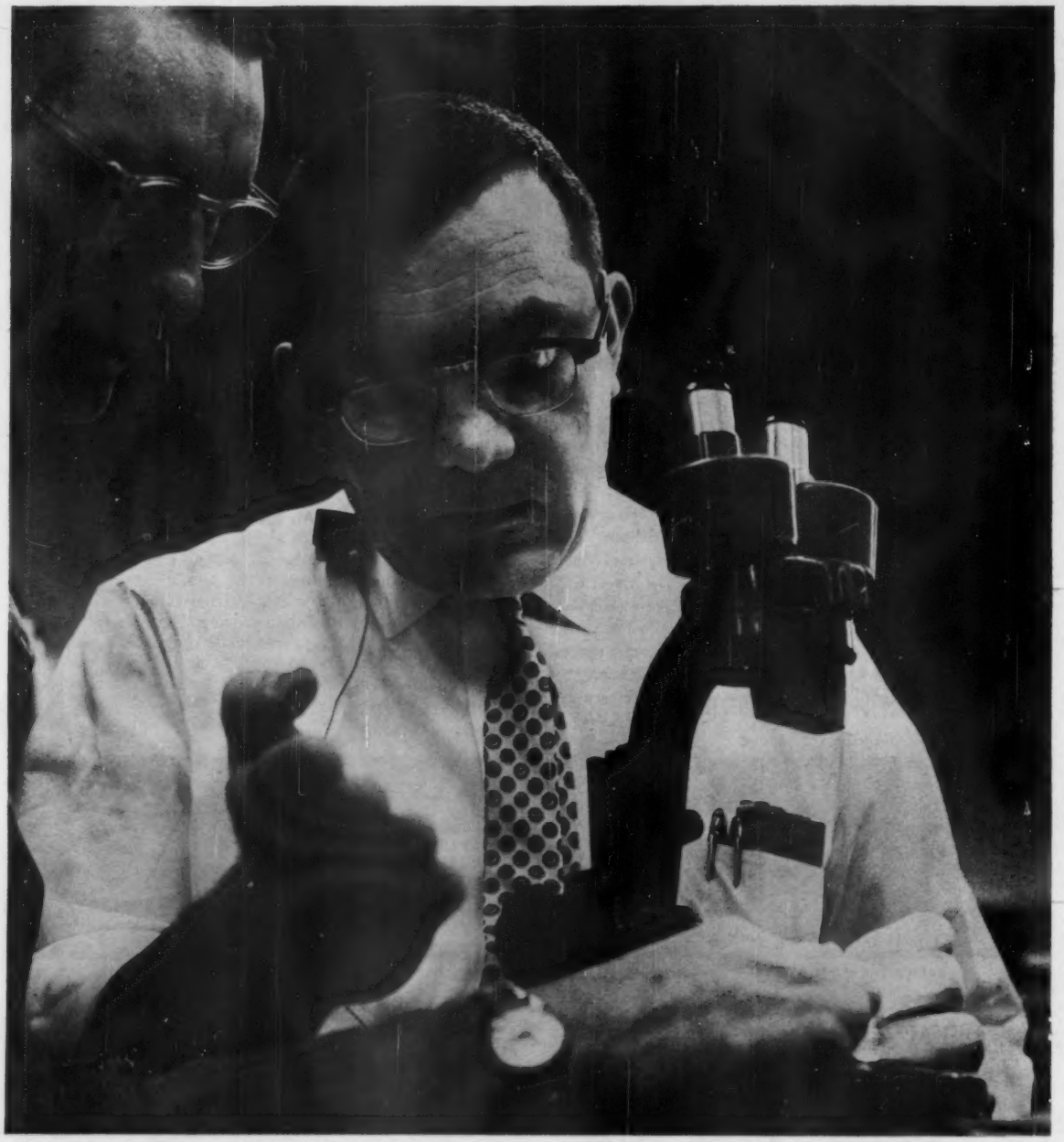

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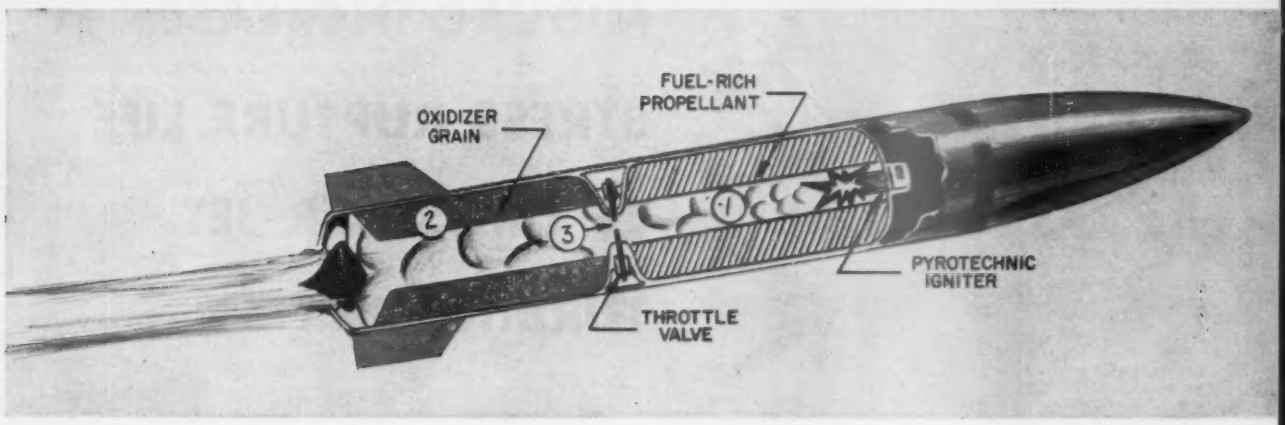


SCHEMATIC drawing of Amcel throttleable solid-propellant rocket shows tandem grains of fuel- and oxidizer-rich propellants.

Solid-Propellant Motor Throttled in Tests

By David A. Anderton

New York—Feasibility of a throttleable solid-propellant rocket motor has been demonstrated in a series of static firings by Amcel Propulsion Inc.

Test runs covered a thrust range between 20% and 65% of maximum static rating—about 450 lb.—of the test motors. Specific impulse averaged about 93% of theoretical value through the test range.

Both thrust termination and motor restart have been done during the company-funded test program. Based on these first runs, Amcel predicts conservative throttling ratios as high as 40:1.

Current testing is being done with fixed orifice plates simulating the throttle. Scatter of test points is not great, and is attributed largely to the use of experimental grains produced without benefit of high-rate production techniques.

Mechanical design studies of the throttle show that a simple device—perhaps no more elaborate than a movable pintle—will handle the thrust control job.

Low-Thrust Throttling

Next phase of the Amcel program is aimed at low-thrust throttling and tailoring of specific propellants. Company will not specify either propellant component, but says the performance level of the current combination is 227 sec. specific impulse for expansion from 1,000 psi. chamber pressure through a 10:1 nozzle. Test motors are built up from the Army's standard ballistic evaluation motor components, which feature cases two inches in diameter by seven and one-half inches long. Two of these cases and the throttling orifices are assembled with standard head and nozzle plates for test articles.

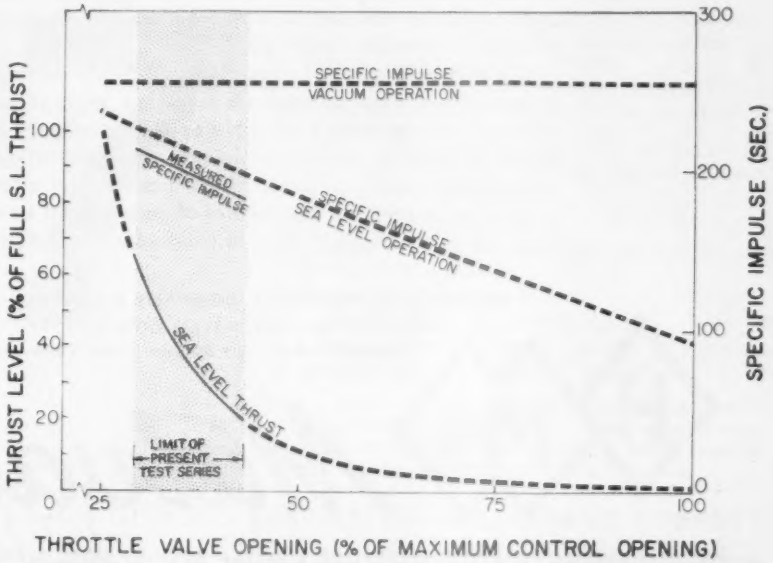
Basis of the design is the separation of the propellant into separate tandem grains, one fuel-rich and the other oxidizer-rich. The throttle is between the grains.

In firing, the fuel-rich grain is ignited and its exhaust is discharged through the nozzle and through the oxidizer-rich grain, where further reaction occurs.

Closing the throttle results in increased chamber pressure and burning rate in the fuel-rich section, which increases the reaction in the oxidizer chamber and therefore the over-all thrust of the motor. Thrust termination is by rarefaction wave, forced by sudden opening of the throttle. Multiple igniters, protected by ablating plugs, are used for restarting the motor.

Oxidizer Grain

Development of the oxidizer grain is credited largely to the company's explosives experts, who decided to work backward from a pure oxidizer to an inerted material containing just enough desensitizer to keep it from exploding. They ended with a solid grain containing about 90% ammonium perchlorate. The grain can be slammed on the ground, will not burn except in the presence of fuel, and will not explode



THROTTLING experiments covered thrust range between 20% and 65% of maximum rating.

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The Midvac Process of consumable electrode melting eliminates atmospheric contamination, ingot soundness is improved, segregation is reduced, workability is increased and product quality is stepped-up. Midvac Steels are offered in many alloys as billets or forgings to meet the most critical design specifications of jet engine parts, missile and aircraft components and other products requiring properties beyond the capabilities of conventional steels. Let M-H metallurgists help you select the right alloy to meet your product's specifications. Write . . .

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even when subjected to the shock of standard blasting caps and tetryl pellet initiators.

Curiously, the inerting substance which makes the oxidizer safe to handle also becomes an active ingredient in the mix and improves the performance. Amcel says grains are made by conventional propellant, chemical or explosive techniques.

Weight penalty in the motor is minimized by the split-grain makeup. First, the throttle operates in a relatively low-temperature blast of gas from the fuel-rich grain during burning. This means both decreased temperature and erosion, simplifying the mechanical and material problems of the throttle design. Second, although the fuel-rich chamber operates at higher pressures and therefore requires a heavier shell case than usual, there is considerably more oxidizer to house than fuel. The weight penalty attaches to the smaller section of the casing only.

Amcel feels the throttleable solid motor offers two attractions: First, thrust control; second, major improvements in motor performance—up to 300 sec. specific impulse—by using grains of materials normally incompatible if mixed in the same grain structure.

Director Chosen For British Consortium

London—British Space Development Co., a consortium of United Kingdom industrial firms primarily interested in space for commercial uses, will be headed by Sir Robert Renwick, director of Associated Electrical Industries and Associated Television, two of the member firms.

Top priority has been given to the development of proposals for use of space in the communications field, he said. In a broad sense, the consortium will "examine ways and means Britain shall assume a significant role in space technology."

The group was formed earlier this year, and selection of directors and evolvement of initial aims was spurred by the Russian man-in-space flight, an achievement which caused criticism of Britain's lack of a space endeavor.

Its technical committee includes the U.K.'s top scientists and technologists and is headed by G. K. C. Pardoe, leader of the de Havilland Blue Streak missile team.

Consortium members besides Associated Electrical Industries and Associated Television are British Insulated Callender's Cables, Decca Radar, Hawker Siddeley Aviation, the Plessey Co., Pye Telecommunications, Rank Television and General Trust, and Rolls-Royce.

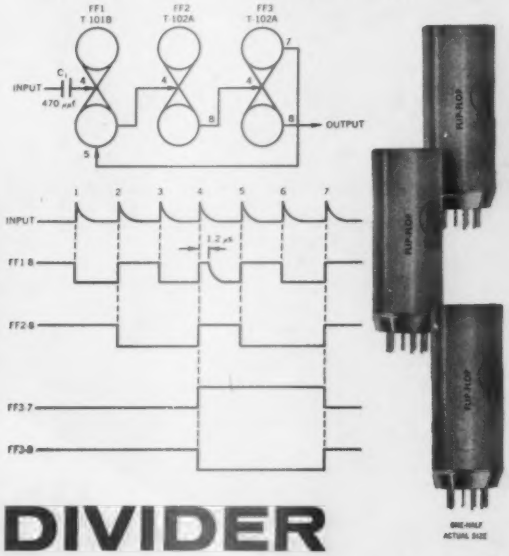
EECO CIRCUIT APPLICATIONS
(No. 2 of a Series)

N/7 DIVIDER

CIRCUIT DESCRIPTION — No reset inputs are required for this circuit because all flip-flops are reset when an output level shift is generated and the circuit is ready for another cycle of operation. The first input pulse triggers flip-flop FF1 to a set state and the voltage at FF1-8 drops to —11 volts. The second input pulse triggers FF1 back to a reset state and the voltage at FF1-8 rises toward —3 volts. This rising voltage triggers FF2 to a set state and the voltage at FF2-8 drops to —11 volts. When the third input pulse is applied, FF1 is again set. The fourth input pulse triggers FF1 back to a reset state. At this time, the following events occur: (1) the rising voltage at FF1-8 triggers FF2 back to a reset state; (2) as FF2 resets, the rising voltage at FF2-8 triggers FF3 to a set state; and (3) as FF3 sets, the rising voltage at FF3-7 is fed back to FF1-5 and sets that flip-flop. Each of the three events just described occurs after approximately 0.3-microsecond switching time at each flip-flop and, thus, the complete sequence of events following the fourth input pulse requires approximately 1.2 microseconds.

The fifth input pulse triggers FF1 back to a reset state and the rising voltage at FF1-8 triggers FF2 to a set state. The sixth input pulse triggers FF1 back to a set state. When the seventh input pulse is applied, the following events occur: (1) FF1 is reset, (2) the rising voltage at FF1-8 triggers FF2 to a reset state, and (3) the rising voltage at FF2-8 triggers FF3 back to a reset state. Again, approximately 1.2 microseconds of time are required to complete this sequence of events.

As FF3 is reset, the voltage at FF3-8 rises to provide an output d-c level shift signalling that seven input pulses have been received. The divider has now completed one cycle of operation and all flip-flops are in a reset state. Subsequent input pulses will cause the circuit to cycle as just described, thus providing an output level shift from —11 volts to —3 volts each time seven input pulses have been applied.



This circuit is presented primarily to show how feedback can be used in counting circuits to effect any non-binary count using binary circuits.

An N/7 divider is a circuit that generates one output pulse for each seven input pulses. If, for example, input pulses are applied at a 70 k-pps rate, the circuit provides outputs at a 10 k-pps rate. The EECO N/7 divider circuit described here can operate at input pulse rates up to 150 k-pps.

EECO T-SERIES MODULES

The circuit employs the following three T-Series germanium plug-in circuits:

1 only T-101B Flip-Flop (FF1)
2 each T-102A Flip-Flops (FF2 and FF3)

In addition, a 470 μμf external capacitor (C_1) is used between the input source and pin 4 of FF1.

This is typical of the many practical applications of EECO T-Series Germanium plug-in circuit modules. We stand ready to furnish circuit modules and application data to meet the needs of your specific problems. Write or wire today.

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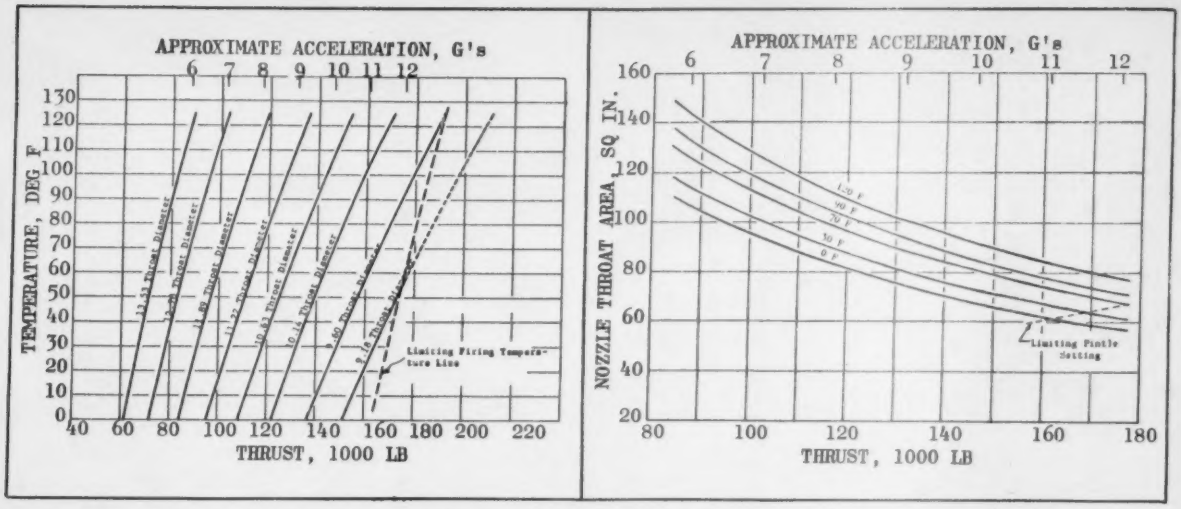


THRUST AND ACCELERATION variations are possible with Megaboom sled booster using eight different sizes of replaceable nozzle throat inserts. Pintle nozzle on Megaboom sled booster (right) is calculated as providing these thrust and acceleration variations.

Variable Rockets Studied for Test Sleds

Important savings in time and cost of rocket sled test programs can be achieved by development of variable thrust capability for this class of powerplants, according to a Rocketdyne engineer.

Utilization of variable thrust systems would permit use of two or three basic booster sizes covering a wide range of thrust levels. These can be adjusted or programed in the field by test personnel to meet specific sled propulsion needs rather than experience delivery delays of tailored boosters, or continuing expensive development of new motors, R. T. Cliffe, Solid Propulsion Operations, Rocketdyne, McGregor, Tex., noted during a supersonic track symposium held at China Lake, Calif., recently.

Lead-Time Problem

Sled propulsion requirements for supersonic track testing are seldom known with sufficient lead time—nor is there sufficient money available, to develop or tailor a solid propellant booster to provide desired thrust-time programs, Cliffe stated.

Two promising basic methods of varying motor thrust are the variable nozzle throat area and case venting, Cliffe reported.

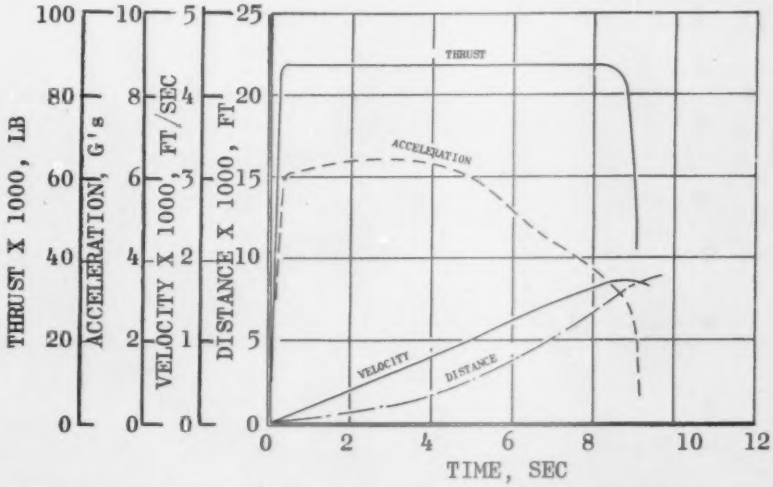
A preset thrust level can be achieved by merely matching a nozzle or nozzle throat insert to the internal ballistic characteristics of the motor. With changeable nozzles, only particular thrust levels can be selected, because of the infinite variety of nozzle sizes obtainable, he noted. But by inserting a tapered center-body or pintle into the throat of a conventional convergent-divergent nozzle, an annular throat area can be formed that is varied by positioning the pintle along the flow axis—the pintle nozzle providing unlimited variation in throat area and thrust magnitude within two limiting values.

Rocketdyne has sponsored a research program that successfully demonstrated this system on M-15 JATO motors. A conical pintle was used in a conventional convergent-divergent nozzle, a threaded adapter ring being installed in place of the standard nozzle and a larger convergent-divergent nozzle fitted so that the basic motor would not have to be modified. Thrust levels with these nominal 1,000-lb.-thrust motors were restricted to the range of 1,250 lb. maximum to 750 lb. minimum, corresponding to the maximum safe case pressure and minimum pressure for stable burning for the M-15.

This variable area nozzle design maintained a constant nozzle exit area so that at reduced throat area a greater expansion area ratio was obtained along with the increased chamber pressure.

Command Throttling

Command throttling was demonstrated with a pintle-nozzle design on the M-15, a stepped displacement controller being used to decrease, then increase the thrust in steps. Transient peaks and valleys which accompany



PRESSURE RELIEF-VALVE design (at minimum thrust value) would produce these acceleration, velocity and track distance time histories for Megaboom booster.

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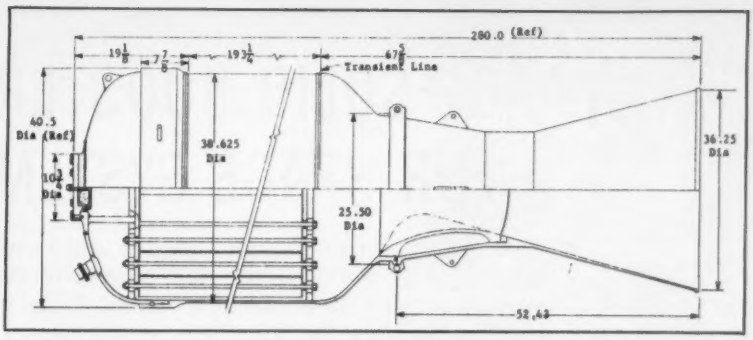


CHANGEABLE NOZZLE design for Megaboom solid propellant sled booster could utilize throat inserts of mild steel flaring into the standard conical nozzle expansion cone.

thrust level changes resulted from a rapid change in throat area followed by a slower change in chamber pressure.

A step change in throat area, with chamber pressure remaining essentially unchanged, caused thrust to change in the same direction as area change. This chamber pressure response to changes in throat area is a strong function of the free volume inside the rocket case as well as the rate of change of throat area. These thrust transients can be reduced by close control of the rate of area change.

Case venting systems function in a similar manner, differing from the variable throat area systems in having a fixed convergent-divergent nozzle to develop the thrust and controlling chamber pressure by means of an auxiliary vent. Vents can be of two types: a manually preset vent or varying pressure by means of controlled vents.

Either of these types can use radially or axially vented ports—in the former, combustion gases pass through the vent and then are discharged through two or more radially opposed ports to maintain side force at zero; axially vented systems would discharge gases through ports that are effectively parallel to the main nozzle. Thrust increase is minor as the ports are inefficient as a nozzle.

Vent Area Control

The vent area can be controlled by several methods. Interchangeable orifices or a pintle-orifice can be used.

The pressure relief valve principle may also be used as a case venting system of thrust-magnitude control. A compression spring or torsion bar, proportional to the desired chamber pressure, would keep the valve closed. As pressure rises inside the rocket motor case, the valve opens at the desired pressure and maintains this level by bleeding off excess combustion gases. Small hot gas pressure-relief valves, capable of maintaining a preset value within 10% of desired levels, have been used successfully in numerous solid propellant devices, Cliffe noted.

Considered in the discussion was adaptation of a Rocketdyne 10-NS-100000 Megaboom solid propellant motor which has been employed in sled tests at Holloman AFB. The ammonium nitrate oxidized propellant used in this booster has a theoretical flame temperature of 2,600F, would permit thrust control mechanisms to operate satisfactorily up to 25-sec. without being insulated, according to Cliffe.

Changeable Nozzles

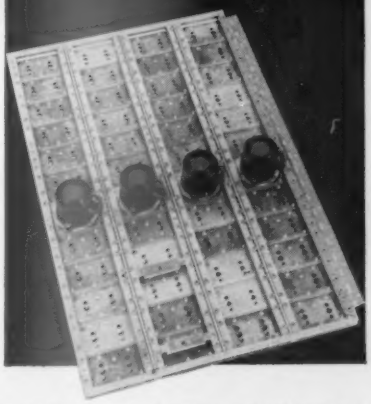
The initial method he considered for preselecting the thrust level of a Megaboom is using changeable nozzles. Changeable nozzles for a booster this size would present a problem to field personnel, he noted, but throat inserts can be built that will flare into a standard conical nozzle expansion cone.

Mild steel castings, machined for a particular throat area, can be used for inserts. Ribs at intervals around the periphery of the castings serve to reduce weight and facilitate handling. The throat inserts are fitted into a retainer in the entrance section of the exit cone. Eight sizes of throat inserts would cover the range of acceleration required with an accuracy of approximately plus or minus 1g.

A pintle nozzle may also be used for attaining preset thrust levels, Cliffe noted. A steel pintle, mounted on a threaded, adjustable shaft located upstream of the conventional nozzle throat, could be driven by means of gearing from the side of the aft closure. A calibrated scale, attached to the pintle drive, would indicate the position of the pintle in the nozzle throat. With the pintle retracted fully upstream, the throat area is maximum; extended fully downstream, the throat area is minimum. Between these extremes there would be unlimited variation of thrust level adjustment.

Relatively low flame temperature of the propellant and burning time of less than 15 sec. permits use of mild steel to be used in the entire pintle structure. Supports could be fabricated from mild steel, welded, stress-relieved and ma-

Environmental conditioning *for* *detection systems*



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chined for alignment. A dry lubricant such as Molykote would be used on threads and gears.

One radially vented, spring-loaded pressure relief valve described by Cliffe would be attached to the aft head of the booster to control thrust by keeping chamber pressure constant. Pressure is held at a level by controlling the compression force applied to a large spring which acts on a conical piston to vent the chamber whenever burning tends to produce an over-pressure.

Continuously varying the thrust of a booster during a sled run by means of a variable-area nozzle is feasible, according to experimental work at Rocketdyne's Solid Propellant Operations, McGregor, Tex. A control system can be incorporated into the variable area nozzle design which automatically senses sled acceleration, compares this with desired values and repositions the pintle to increase or decrease the thrust as desired.

A problem in this system is the possibility of undesirable transient thrust peaks and valleys accompanying rapid changes in throat area, Cliffe pointed out. Because of its size and mass, the pintle on the Megaboom-type booster should be pre-positioned for desired initial acceleration. Thus pintle movement can be limited to gradual changes and these undesirable transients can be avoided.

As an alternate method of varying thrust magnitude, a sleeve over a tube mounted on the booster aft head could be utilized, providing a variable vent area by rotating the sleeve to align openings through this port into a plenum from which it exits through radially opposed ports. Automatic thrust control is provided by using a hot gas servo to rotate the sleeve to the desired vent area, the working gas for the servo motor being tapped directly from the booster chamber.

Japan to Fire Monkey To 600-mi. Altitude

Tokyo—Japanese space and medical scientists are planning to launch a rocket with a trained monkey aboard.

The Environmental Medicine Research Institute of Nagoya University has begun medical screening of monkeys at the request of the Tokyo University Institute of Industrial Science to study effects of space flight on cardiograph and electric-cerebral waves of live animals.

A live female monkey less than one year old will be placed in a heat-resistant chamber supplied with oxygen when the Tokyo University Institute launches a Lamda rocket to an altitude of about 600 mi. from its new launching site on the southernmost island of Kyushu this fall.

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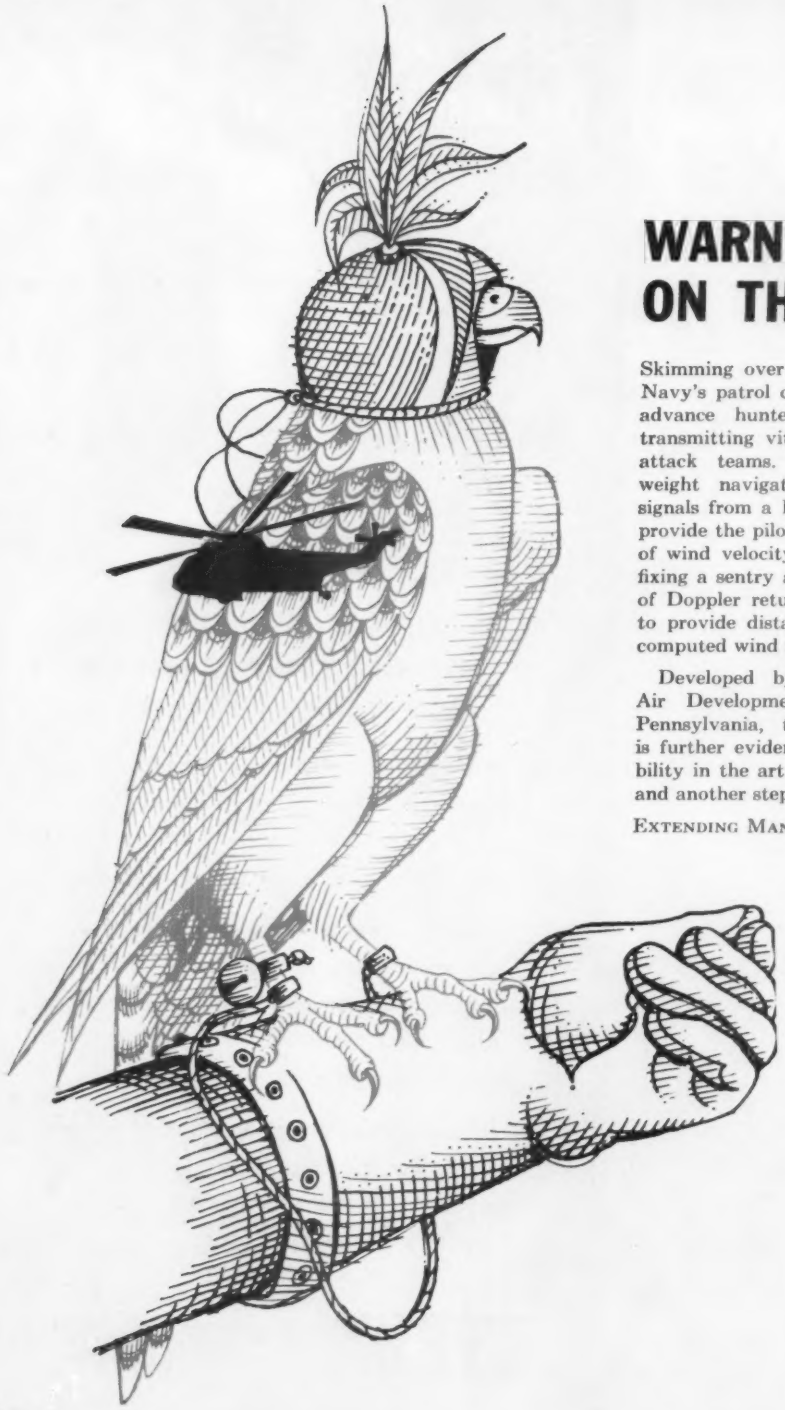

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PRODUCTION BRIEFING

Bendix Corp.'s Products Division, South Bend, Ind., will develop a pan-shaped nose gear for Dyna-Soar manned space glider under a $75,000 subcontract from Boeing Co. Gear will be retractable and be fitted on underside of fuselage. Boeing is scheduled to award another contract to industry to develop an unconventional aft landing gear.

Marquardt Corp. has been awarded a $4 million Air Force contract for additional research in the development of Project Pluto nuclear ramjet engine. Marquardt is coordinating its effort with the University of California Lawrence Radiation Laboratory, which will demonstrate Pluto reactor feasibility.

Wyle Laboratories, Inc., will perform vibration testing on the Skybolt air-launched ballistic missile rocket motors for Aerojet-General Corp. Testing will be at Wyle's Norco, Calif., hazardous-test site.

Royal Industries, Inc's Royal Jet Division, Alhambra, Calif., will supply specialized containers for Falcon missiles under a $750,000 contract from Hughes Aircraft Co.

Canoga Electronics Corp. will build five airborne timing systems for the Air Force Missile Test Center, Patrick AFB, under a $120,000 contract.

American Electronics, Inc.'s Precision Power Division, Fullerton, Calif., will produce electric power units and power supplies for installation at underground Minuteman launch sites under two contracts awarded by Boeing Co. Initial power units contract is estimated at more than $600,000, the constant-voltage type power supplies award at more than $160,000.

Douglas Aircraft Co. has completed a new $450,000 liquid-hydrogen laboratory at Santa Monica, Calif., where research will supplement liquid hydrogen propellant fueling and loading experiments at Douglas' Sacramento field station. It also will permit a wide range of testing for Saturn S-IV components at extreme low temperatures, including evaluation of cold helium systems for fuel pressurization for the S-IV. Facility capabilities include burst testing at up to 20,000 psi. and flow-rate tests of 2,000 gpm. at pressures up to 125 psi.

Pastushin Industries, Inc., has received a $955,000 contract from Navy's Bureau of Weapons to design and manufacture 300-gal. external jettisonable fuel tanks for the carrier-based Douglas A4D.

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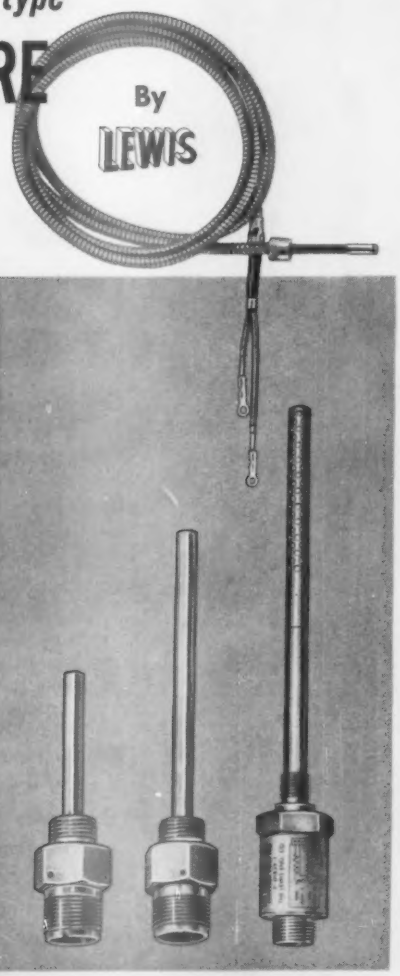
By LEWIS



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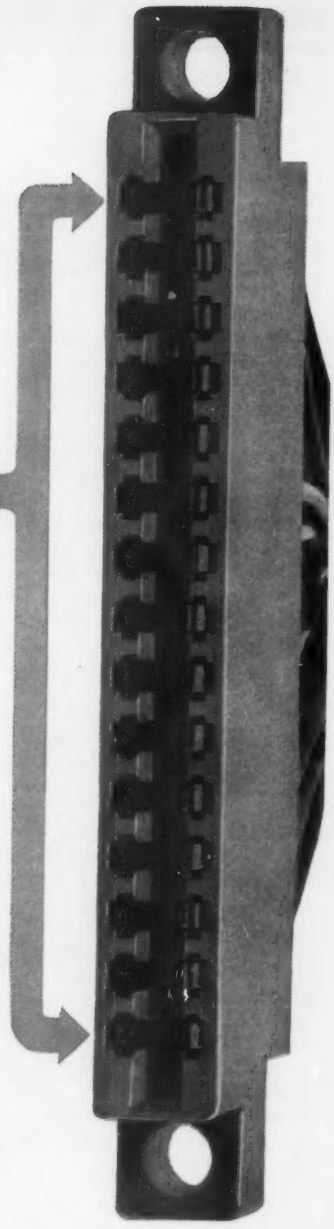
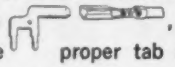


The **only** contacts you pay for in an AMPin-cert printed circuit edge connector are the ones you actually **use** for your specific circuitry, and here's why: AMPin-cert contacts are not fully pre-loaded into the housing. The unique AMP design, crimping wire directly to the contact, permits you to attach conductors to contacts **before** you load them. When you don't need two or three or six or seven of the available contact cavities, or a complete row of cavities in the case of one-sided boards, you don't load the contacts . . . and you don't pay for them!

So much for economics. What about contact versatility? The AMPin-cert line has five distinct types of contacts: Type I, AMP-leaf , a configuration which guarantees contact forces even on minimum-thickness boards. Type II, AMP-blade  , a molded male tab housing to insure proper tab alignment, and a crimped type snap-in female receptacle offering three long, positive contact areas. Type III, DUO-Tyne , affords extremely high density, has four contact areas. Type IV, the right-angle AMP-flag DUO-Tyne , allows conductors to come out of connector at right angles, for easy cabling. Type V, AMP-taper in , ideal for quick jumpering, circuit change-over applications, accepts AMP taper pins.

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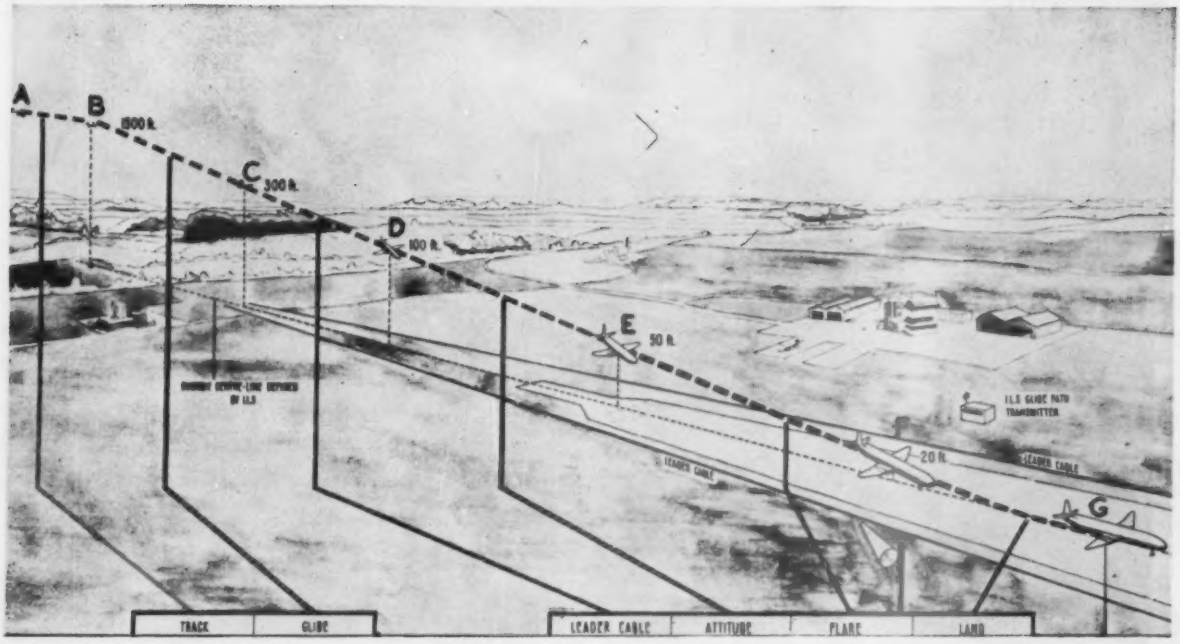

BRITISH BLEU automatic landing system, now being installed at Atlantic City for Federal Aviation Agency evaluation, is one of several automatic landing systems which require critical transition from ILS beams to another system at extremely low altitude. This has prompted airlines to think of improvements in ILS which would permit safe automatic approaches to below 100 ft. where pilot could then use high-intensity approach and runway lights to execute regular manual flareout and landing.

ILS May Handle Automatic Blind Landing

By Philip J. Klass

Washington—There is a growing airline industry belief that the long-sought goal of all-weather operations may come from improvements in existing equipment and facilities rather than from one of the several automatic landing systems now under development or test.

Evidence to substantiate or negate this view should come during the next several years as the airlines gain experience in the use of automatic pilots and approach couplers, new approach lighting and the improved directional localizers which the Federal Aviation Agency is installing at 10 airports.

Recent under-the-hood tests by Pan American World Airways and Boeing suggest that it may be feasible to make automatic (coupled) ILS approaches down to altitudes below 100 ft. in jet transports. At these altitudes, direct transition to high-intensity approach lights may be possible, permitting the pilot to make a manual flareout. Recent flight tests suggest that the acceleration characteristics of split-compressor and turbofan engines are sufficiently good to permit a jet transport to abort successfully an automatic approach at altitudes of 50 ft. and perhaps lower.

There are several reasons why the airlines would prefer to use the present ILS with direct transition to visual landing, if this proves feasible, instead of the installation of separate new automatic landing systems. However, industry is not opposing development and test of automatic landing systems.

• **One less transition:** All of the automatic landing systems under development require the use of ILS for the approach, which means a transition from ILS to the landing system at relatively low altitude, and a transition seconds later by the pilot to visual contact. For systems like the British BLEU, now being installed by FAA at Atlantic City for evaluation (AW Apr. 24, p. 40) and the Autonetics APN-114

NEW DIRECTIONAL localizer antenna, employing slotted waveguide array, provides more accurate and more stable ILS localizer which should permit lower altitude instrument approaches even at airports with adverse siting. New antenna, now installed at Meacham Field, Tex., is planned for installation at 10 other airports.

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flareout adapter, this critical transition from ILS takes place at an altitude of only 50-100 ft.

• **Difficult to pre-check:** Low approach using ILS has the advantage that a pilot can check operation of the beams and his approach coupler while the aircraft is above 1,000 ft. altitude. The pilot cannot positively check the operation of the automatic landing system airborne equipment until transition is made to the system at low altitude.

• **No additional equipment:** If ILS in combination with auto-approach couplers can successfully permit jet transport approaches down to 100 ft. or less, allowing direct transition to visual contact, no additional airborne or ground-based facilities would be required.

Pressures for Improvement

The recent action of major airlines to clean up design, maintenance and usage problems in their jet transport autopilots, approach couplers and flight directors in an effort to obtain FAA authorization for lower jet transport minimums, is expected to produce a chain reaction which will do much to improve the industry's all-weather operations.

If FAA grants authorization for lower jet transport minimums, it is expected to do so on a selective basis for specific airports, whose ILS and lighting facilities are adequate, and for those airlines whose auto-approach coupler reliability and pilot proficiency justifies such action.

Previously, when approach couplers and flight directors were considered only as accessories of convenience, there was little economic incentive to the carriers to invest heavily in the required maintenance and pilot training. But if one carrier is able to maintain jet transport schedules under 200-ft., ½-mi. minimums while its competitor is forced to cancel for lack of such authorized minimums, the latter will have considerable economic incentive to make the required investment in auto-approach coupler maintenance and pilot training, observers believe.

Pressures also will be generated for the FAA to improve the quality of ILS facilities at major airports. As long as instrument approaches are made manually, where the human pilot can adjust to noise or wiggles in the ILS beams based on previous experience, there is little pressure to improve the facilities.

But an auto-approach coupler is less flexible and more demanding of good quality ILS beams, so the FAA can expect to be inundated with complaints on inadequate installations once the airlines start to make widespread use of approach couplers.

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ultimately will feel the pressure. Aircraft flight characteristics in the past have been designed for manual flight, and autopilot manufacturers have long been relegated to a low priority in original aircraft flight testing. As the economic payoff from lower-minimum operations becomes apparent, observers expect that aircraft manufacturers will take a keener interest in the automatic flight characteristics of the airplane, particularly at low altitudes in final approach.

Strong pressures will develop for autopilot manufacturers to improve the reliability of their equipment. Based on progress that has been made in avionic reliability for important missile and space programs, and the availability of extremely high-quality, high-reliability components, transistors and tubes, there is no reason why an autopilot cannot be as reliable as airlines communication-navigation equipment.

ATA Recommendations

The Air Transport Assn.'s All-Weather Operations Committee, formed a year ago, has come up with several recommendations for improvements in the autopilot and its approach coupler, as well as for flight directors:

- **Better warning system:** A more positive warning system, suitable for operating an external alarm buzzer, is needed to indicate failure within the autopilot and approach coupler.
- **Improved ground checkout:** Better equipment is needed to enable maintenance personnel to test autopilot and approach coupler on the ground to be sure they are functioning properly.
- **Simplified cockpit controls:** Design of existing autopilot-coupler console controls is too complex, particularly during instrument approach phase when pilot needs three or more hands. Lear, whose L-102 will be used on United Air Lines' new Caravelles, is demonstrating a control column steering feature which would permit pilot to use the control column to change altitude or heading when the airplane is flying on autopilot. There appears to be at least some airline interest in this approach toward simplifying autopilot controls.
- **Improved display:** In addition to simplified controls, ATA's committee calls for a better cockpit presentation "to give the pilot full appreciation of what's going on in an automatic system to permit the least painful transition from 'inside the cockpit' to 'outside the cockpit.'"

At a recent FAA International Aviation Research and Development Symposium in Atlantic City, A. B. Winick of the agency's Bureau of Research and Development reported the results of tests run on the new improved directional localizer, installed at Meacham Field, Ft. Worth, Tex. The directional localizer, which uses a 117-ft. waveguide aperture instead of the conventional localizer antenna array, was developed for use at airports where reflections from nearby buildings cause excessive bends in the beam produced by a conventional localizer antenna.

Despite the unfavorable antenna location at Meacham Field, the directional localizer has demonstrated a very high stability and accuracy, Winick reported.

Measurements made over a period of two years indicate that the center of the localizer beam remained within 0.084 deg. of the runway centerline 95% of the time. During the last eight months of the test period, 96% of the measurements showed the localizer beam center to be within 0.038 of the runway centerline.

Scaling this latter figure to the threshold of a 10,000-ft. runway indicates the capability of maintaining a localizer beam to runway center tolerance of only seven feet 96% of the time, Winick said. This was achieved using a transmitter at Meacham which is now 10 years old.

Another important characteristic for a localizer is course width stability, particularly for automatic approach coupler use. A series of 19 flight checks conducted routinely over a two-year period showed the beam width to be within 4.6 to 5.5 deg., slightly less than half of the International Civil Aviation Organization (ICAO) standard, Winick pointed out.

There had been a question whether aircraft overflying the directional localizer antenna might reflect sufficient energy to seriously distort the localizer beam. FAAs tests and analyses indicate that this is not a serious problem, Winick said.

FAA Plans

The FAA currently has plans to install the new directional localizers at its ILS facilities in the following locations: Washington National Airport, Philadelphia, Chicago-Midway, Minneapolis, Seattle, Juneau (Alaska), Monterey, Calif., Harrisburg, Pa., Greensboro, N. C., and at Atlantic City, N. J. The latter installation will be an experimental one using a 300-ft.-wide waveguide, to evaluate what gains in performance are obtained by increasing the size of the antenna.

At airports where there is no precision approach radar installation, a pilot making an instrument approach can double-check his azimuth position relative to the localizer by means of his automatic direction finder or fixes obtained from other omnirange stations.

More disturbing to the pilot's tranquility is the question of the aircraft's altitude relative to the ground and other

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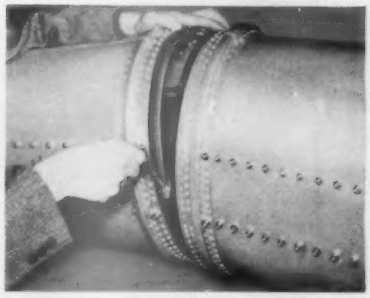
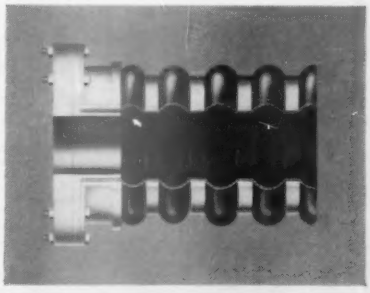


ZIPPERED DUCT SEAL. BFG zipper closures permit easy access to enclosed equipment such as this air duct. Seals effectively against liquids, gases, dust, dirt, corrosion. BFG zippers can be custom-fabricated for your product, or supplied as part of a complete closure.



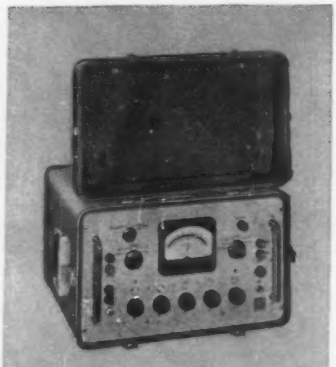
FLEXIBLE FUEL-LINE CONNECTOR. Special flexible rubber joint reinforced with metal bands ideal for aircraft fuel line systems. These connectors serve as expansion and universal joints where loads and deflections are severe. Withstand bending and torsion —save weight.

HEAT PACKAGE. BFG fabricates rubber shapes with integral electric heating elements for controlling ice formation in localized areas such as air intakes, cowls, propeller blades, spinners. Fabricated to fit perfectly to complex curves or odd shapes.

For more information check your B.F.Goodrich Aviation Products Representative, or write *Aviation Products, a division of The B.F.Goodrich Company, Dept. AW-5B, Akron, Ohio.*

NOW easy—0.05% voltage measurement under severe environmental conditions

MODEL 8011A MILITARIZED DIFFERENTIAL DC VOLTMETER



Meets all environmental requirements of MIL-T-945A

Designed for continuous operation:	—from −54°C to +65°C —with 95% relative humidity —up to an altitude of 10,000 feet
Designed for extended storage:	—from −65°C to + 85°C —with 100% relative humidity —up to an altitude of 50,000 feet.

FEATURES

- **Accuracy of 0.05% of input voltage from 0.1 to 500 volts.**
- **Infinite input resistance at null.**
- **No zero adjustments.**
- **Eight search and VTVM ranges.**
- **Four potentiometric ranges.**
- **Temperature controlled Zener reference.**

Model 8011A is a true potentiometer built to provide accurate voltage measurements under adverse environmental conditions. Housed in a light grey enameled combination case, it is portable, and virtually impossible to damage by overload. ■ Chopper stabilized null detector, precision Kelvin-Varley resistors (hermetically sealed in oil), temperature controlled Zener reference, and drift free 500 volt reference supply, all contribute to the outstanding performance of this instrument. ■ For your application requiring accuracy, reliability, plus ease of operation specify the John Fluke Model 8011A.

ONE PIECE CASE

Combination transit and instrument case of deep drawn aluminum construction protects the electronic circuitry from dust, moisture and drafts. This unique feature enables the Model 8011A to provide laboratory performance under the most severe environmental conditions.

PARTIAL SPECIFICATIONS

VOLTAGE RANGES:	±0.5, 5, 50 and 500V DC
ACCURACY:	±0.05% from 0.1 to 500V ±0.1% of input voltage or 50uV, whichever is greater below 0.1V
NULL SENSITIVITY RANGES:	10V, 1V, 0.1V & 0.01V
MAXIMUM METER RESOLUTION:	50uV
INPUT RESISTANCE:	Infinite at null from 0 to 500V
DIMENSIONS:	Case covered, 11½" high, 19" wide, 19½" long
WEIGHT:	57 pounds complete
PRICE:	Available on request

Prices and data subject to change without notice

FLUKE

JOHN FLUKE MFG. CO., INC.
MOUNTLAKE TERRACE, WASHINGTON

terrestrial obstructions. Although the barometric altimeter and the outer and middle marker beacons give the pilot a periodic check on his vertical position, there is some thought that additional confirmation would be desirable.

For example, if the airport is equipped with a Vortac installation, and the aircraft carries distance measuring equipment (DME), a very simple computer could be devised to calculate what the aircraft's barometric altitude should be as it moves down the glide slope and continuously compare this value with the actual aircraft barometric altitude.

It also has been suggested that if inexpensive corner reflectors were placed at an airport, airborne weather radar could be used to give the pilot a display of his progress toward the runway.

Installation of Vortac at major airports also should permit autopilot manufacturers to improve the performance of their approach couplers by providing a distance-from-touchdown signal which can be used to automatically vary the autopilot system gain as the aircraft approaches the runway.

Open Mind

While the airlines seek maximum all-weather utilization from existing ground and airborne equipment, they fully support the FAA's efforts to evaluate new automatic landing systems.

The FAA has sent a Douglas DC-7 to Britain for installation of the airborne equipment required for the BLEU automatic landing system. The aircraft will be checked out on the British ground facilities before returning to Atlantic City for FAA tests. The DC-7 will be outfitted to use either the British-developed magnetic leader cables or the FAA's new directional localizer for lateral guidance.

North American Aviation's Autonetics Division is scheduled to deliver its AN/APN-114 automatic flareout system to FAA this summer, installed in a Convair F-102, for flight test and evaluation. The Autonetics system is similar to the flareout portion of the BLEU system, but is somewhat more sophisticated and complex. Both use a radio/radar altimeter to measure aircraft altitude and an analog computer to calculate the optimum flareout path to be followed.

FAA also is testing the Bell AN/GSN-5 automatic landing system, developed under Air Force sponsorship, which employs a precision tracking radar and computer, both ground-based. Also under FAA test is the elevation/glide slope portion of the Gilfillan Regal system. Still another system, called Eagle, which has been developed by Airborne Instruments Laboratory, may also be evaluated by the FAA.

ANOTHER INERTIAL INSTRUMENT FROM GIANNINI CONTROLS

HEAVY DUTY FEATHERWEIGHT

Giannini #3417 Free Gyro

There's a lot of gyro in this 2-3/4" diameter can. Drift only 0.7°/minute. Resolution 0.1°. Simultaneous uncaging of both gimbals in 0.1 second without gimbal kickoff regardless of input rates. Electrical or manual caging mechanism. AC rotor. Potentiometer or synchro pickoffs. And, when it's from Giannini you get it on time, it works when you get it, and it keeps on working. Send for data sheet #3417.

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PACIFIC OFFERS CHALLENGING OPPORTUNITIES TO ENGINEERS

SERVES THE AIR FORCE WITH PRODUCT RELIABILITY

PACIFIC'S CREATIVE DEVELOPMENT AND MANUFACTURING IN AIRCRAFT, MISSILE AND SPACE VEHICLES has provided the Air Force with satellite electric rotary couplings, cable control systems, capsule restraint systems, rugged relays and other products with designed-in reliability, in the Space Age sense of the word.

PACIFIC'S CREATIVE DEVELOPMENT AND MANUFACTURING IN FURNACE DESIGN has become Legend in the West. Whether in missile or spacecraft—or in laboratory research—Pacific can design, build and install the *ONE* best furnace for your needs, whether it be a large Gantry or a 5500°F vacuum.

For information on Pacific facilities and capabilities, please write to:

PACIFIC SCIENTIFIC COMPANY
P. O. Box 22019
Los Angeles 22, California

302

We are happy to make these changes! 5/5/61

200 miles down the Atlantic Range, General Electric silicone rubber will help keep him afloat

did

did

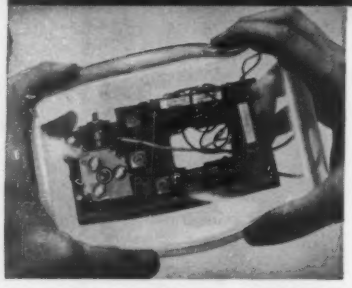
did

Sixteen and a half minutes after its first manned launching, NASA's blunt-nosed Mercury spacecraft will parachute into the Atlantic Ocean.

Here it will float like a buoy marker to await recovery. To help protect the first American astronaut, the Mercury spacecraft is completely sealed with General Electric RTV silicone rubber — the new liquid rubber designed to keep the spacecraft air and water tight even after being subjected to the temperature extremes encountered during take-off, flight and re-entry.

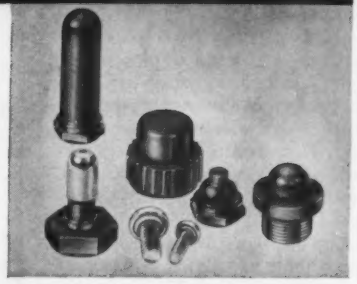
McDonnell Aircraft Corporation, prime contractor for the Mercury spacecraft, applies RTV around rivets and bolts wherever structural material, requiring sealing, overlaps or butts together. Able to cure at room temperature, versatile General Electric RTV silicone rubber has found a wide range of uses in missiles and ground support equipment.

G-E SILICONE RUBBER FINDS MANY USES IN MISSILES AND SPACE VEHICLES



Potting and encapsulating materials protect delicate electronic parts. Clear LTV, shown above, is transparent even in sections several inches thick. RTV liquid silicone rubber encapsulants and clear LTV all exhibit excellent electrical properties, resist shock, vibration, ozone, plus corona and other environmental hazards.

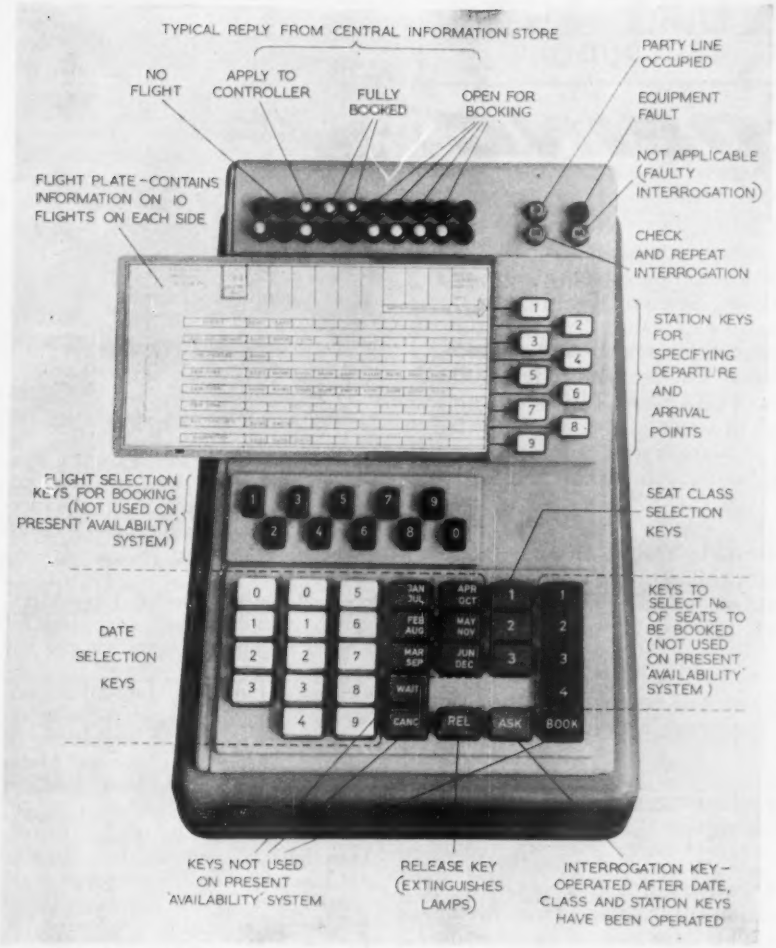
Missile wiring harness, above, is from the Titan propulsion system. G-E silicone rubber wire insulation maintains good electrical properties over wide temperature extremes. Jacketing of high-strength silicone rubber, plus breakouts and junctions molded from RTV were chosen for their insulating properties, resistance to temperature extremes and stability in storage.



Silicone rubber gaskets and seals give long life, heat resistance, and low temperature flexibility in many missiles and space vehicles. Applications range from nose cone gaskets to tiny Seelskrews and Hexseals, by Automatic and Precision Mfg. Company, which combine fasteners with silicone rubber seals for easy assembly.

For full information on General Electric RTV silicone rubber, clear LTV silicone compound, and fabricated silicone rubber parts, write: General Electric Company, Silicone Products Dept., Section J544, Waterford, New York.

GENERAL ELECTRIC


TYPICAL REPLY FROM CENTRAL INFORMATION STORE
NO FLIGHT
APPLY TO CONTROLLER
FULLY BOOKED
OPEN FOR BOOKING
PARTY LINE OCCUPIED
EQUIPMENT FAULT
NOT APPLICABLE (FAULTY INTERROGATION)
CHECK AND REPEAT INTERROGATION
FLIGHT PLATE - CONTAINS INFORMATION ON 10 FLIGHTS ON EACH SIDE
STATION KEYS FOR SPECIFYING DEPARTURE AND ARRIVAL POINTS
FLIGHT SELECTION KEYS FOR BOOKING (NOT USED ON PRESENT AVAILABILITY SYSTEM)
SEAT CLASS SELECTION KEYS
KEYS TO SELECT No OF SEATS TO BE BOOKED (NOT USED ON PRESENT AVAILABILITY SYSTEM)
DATE SELECTION KEYS
JAN JUL
APR OCT
FEB AUG
MAY NOV
MAR SEP
JUN DEC
WAIT
CANC
REL
ASK
BOOK
KEYS NOT USED ON PRESENT AVAILABILITY SYSTEM
RELEASE KEY (EXTINGUISHES LAMPS)
INTERROGATION KEY - OPERATED AFTER DATE, CLASS AND STATION KEYS HAVE BEEN OPERATED

KEYBOARD shows typical flight plate in position, and lamp pattern after interrogation.

Computer Stores Seating Data

London—British Overseas Airways Corp has ordered a computer system to store information on availability of seats for transmission to sales offices in the United Kingdom and Europe. Contract is for $910,000 with Standard Telephones and Cables, Ltd., a subsidiary of International Telephone and Telegraph.

Air France currently is negotiating a contract for a similar system. Computer also can provide information for airlines associated with BOAC and Air France on continuing flights.

System starts with a sales clerk's desk set, tied to a controller's desk set at terminals. These are c nnected with a supervisor's console and the information drum, also in the terminals.

In effect, the sales clerk initiates an interrogation formula to inquire about reservation availability; this is done by inserting an appropriate plate, containing details of related flights for a 20-week period. He then presses buttons corresponding to departure and arrival points on the route sector in question, plus other buttons for dates and class of seating. His reply is visual, through a red-green lamp condition.

Control clerks are responsible for status information to the magnetic drum information store. System allows the clerk to revise flight status in about one second and this information then becomes immediately available to an interrogation on the network.

Information store includes two drums, each of which has 1,000 bit positions on 320 tracks. Capacity of the central processor unit has been designed to handle 8,000 interrogations per hour. Unit also includes a fail-safe system to warn of incomplete messages to the center, damages along the line or out-of-order conditions at the data store.

A BOAC reservation system on order will link the London terminal with ticket offices throughout Europe and U. K.

FILTER CENTER

▶ **Anti-ICBM Technique May Use Optical Maser**—Combination infrared and optical maser tracking and ranging concept likely will get serious consideration in Convair's continuing study of an effective satellite-borne anti-ICBM defensive system under Advanced Research Projects Agency's Project Bambi. Plan envisions infrared detection and tracking of a ballistic missile during its powered phase; and ranging on the target with the high angular resolution optical maser. Similar concept was suggested in at least one unsuccessful proposal in the recent Bambi competition (AW Apr. 10, p. 34, Apr. 24, p. 23).

▶ **Microsystems Conference** – Unusual conference on microsystems in which representatives from five companies will be given a half day to present complete engineering data on their respective approaches to microminiaturization will be held in Los Angeles on May 16 and 17 by the American Institute of Electrical Engineers, Los Angeles Section. Spokesmen from Radio Corp. of America, Westinghouse, Texas Instruments, Fairchild Semiconductor and General Electric will be questioned thoroughly at the conclusion of each session by a panel of engineers from aerospace companies. Meeting will be held at the Institute of Aeronautical Sciences Building, 7660 Beverly Blvd., Los Angeles.

▶ **New Micrologic Circuits Out**—New line of silicon diode micrologic circuits is being made available by MicroSemiconductor Corp., Culver City, Calif., as this firm expands its line of semiconductor products. Basic package of logic circuits containing up to eight diodes which are made on order is 30 mils thickness, 125 mils in width and 250 mils in length. One technique being used involves common active substrate; the other, an individual die mounted on metal substrate is a form of special assembly. Diodes with parameters of 2 nanoseconds recovery time and 2 picofarads capacitance are available for use in these microcircuits.

▶ **Navy Investigates Bat Radar/Sonar**—Tropical species of bat, which is able to locate fish under surface of the ocean while it flies over water by means of its ultrasonic pulse emissions, is being investigated by Harvard University scientists under sponsorship of Office of Naval Research. The tropical bat, known as Noctilio Leopoinus, flies low over the water, until fish has been located then dips its feet into the water to catch its prey. Prof. D. R. Griffin of Harvard, using a small tape recorder and an ultrasonic detector, has made

TRANSACTER

at BOEING

Remote source data collection — a bottle neck in Electronic Data Processing in many "big plant" operations — is no problem at Boeing's Transport Division, Renton, Washington.

We quote, in part, from *BOEING NEWS*, January 12, 1961: "The decision to install the entire network (TRANSACTER* System) came as a result of successful tests conducted . . . by Boeing employees and representatives of Stromberg, manufacturer of the entire system.

"Types of information that employees will 'feed' to the data collecting nerve center will include personal attendance data and detailed information of time spent on specific job assignments.

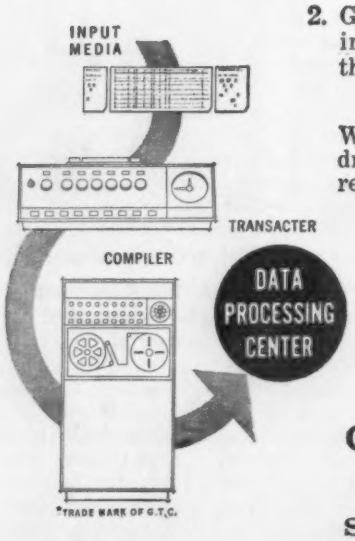
"The information will receive instantaneous treatment at the nerve center regardless of its origin.

"Some of the advantages of the system include the following:

1. Rapid gathering and processing of production information from factory shops. This data is vital in determining shop load and performance factors and in establishing accurate cost targets.

2. Greater accuracy in reports by reducing the margin of error caused through extra handling".

With the TRANSACTER System dramatic new opportunities for cost reduction become evident.



Write for informative brochure. If you prefer, a qualified representative will call.

GENERAL TIME CORPORATION

STROMBERG DIVISION
THOMASTON 2, CONN.

MAKERS OF THE WORLD'S FINEST TIME EQUIPMENT

a tape record of bat's emissions for subsequent study. Bat usually raises pulse emission rate just before dipping, much as insecting bats do before diving on their prey.

▶**New Superconductors Reported**—New alloys made of molybdenum and technetium, which become superconducting at temperatures higher than any other known alloy, were disclosed by Dr. B. T. Matthias of Bell Telephone Laboratories at recent meeting of the American Physical Society. The new alloys, which become superconducting at temperature of 16K, also are very ductile, overcoming an objectionable characteristic of earlier niobium-tin superconductors. Another BTL scientist, D. J. E. Kunzler, reported experiments which suggest that niobium-tin alloy may be able to remain superconducting in the presence of fields as high as 200,000 Gauss at temperatures of about 4K.

▶**Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers include the following:

• **Infrared Industries, Inc.**, Waltham, Mass., $1.5-million contract for development and production engineering of infrared detectors for use on Midas early warning satellites, from Lockheed Missiles and Space Division.

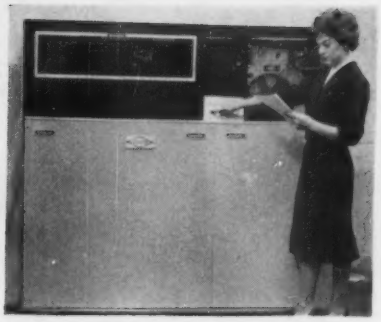
• **Collins Radio Co.**, Cedar Rapids, Iowa, $400,000 contract from Eastern Air Lines for FD-105 integrated flight systems and DF-202 automatic direction finders for EAL's new Boeing 720 jet transports. Collins also reports a $695,000 contract from Sud Aviation for airborne communication equipment for Caravelle jet transports.

• **Intercontinental Electronics Corp.**, $150,000 contract for improved slow-scan converter system from Rome Air Development Center, for converting wideband radar data into narrow-band information that can be transmitted over telephone lines.

• **Bendix Corp.**, Systems Division, Ann Arbor, Mich., a definitive contract for $17.2 million from the Army for Project Advent communications satellite, intended for a 24-hr. synchronous equatorial orbit.

• **SoundScriber Corp.**, North Haven, Conn., $928,227 contract for magnetic tape recording equipment from the Federal Aviation Agency. Equipment will be capable of recording 30 channels of voice communications simultaneously for 17 hr. on one-inch wide magnetic tape. Contract calls for 98 recorders and 40 reproducers.

• **General Telephone & Electronics Corp.**, Sylvania Division, Buffalo, N. Y. $5-million Navy contract for production of communication systems for nuclear-powered Polaris submarines.



Reading Machine

Electronic reading machine can scan typewritten copy containing alphanumeric characters and punctuation at rate of 2½ lines per second, convert typed copy into 6-level Flexowriter code or 5-level teletype code at rate of 240 characters per second. Machine also is available with magnetic tape output. Machine is expected to find use in conjunction with automatic computer translation projects and as a means of rapid entry of printed information into digital computers. Manufacturer: Farrington Manufacturing Co., Needham Heights, Mass.

Tri-Dimension Radars Use Polarized Glasses

Fullerton, Calif.—Hughes Aircraft Co. has developed a three-dimensional radar presentation unit based on the technique using polarized eyeglasses to manipulate visual parallax of the operator tried by the movies a few years ago.

The unit was developed with company funds and has been named Stereoscan. Hughes officials think it may have a role in air traffic control since it can give a controller the ability to see if there is a vertical separation between aircraft. Storage tubes are used in Stereoscan so that a continuous plot of aircraft tracks can be kept on the scope for as long as wanted.

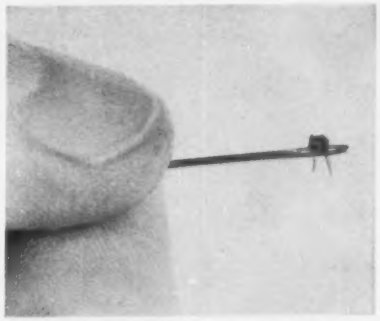
As yet no systematic tests have been run to determine the ability of operators to estimate altitude differences with Stereoscan or to learn how troublesome eyestrain would be to operators equipped with Stereoscan. Hughes officials say such tests will be made.

The maximum "apparent" vertical dimension which can be perceived by controlling binocular parallax is about a foot. Scale can be varied to make the one foot represent any maximum altitude. For air traffic control applications, the maximum altitude would probably be no more than 35,000 ft. and no less than 5,000 ft.

A key question to be answered by operator tests will be the horizontal distance between targets at which a specified minimum altitude separation can be detected.

NEW AVIONIC PRODUCTS

• **Memory system exerciser,** Model 2032, for testing or evaluating complete memory systems during laboratory development or for production testing. Device operates with address-to-address cycle times which are continuously variable from 3 to 100 microseconds and can accommodate random access or serial buffer memories with capacities up to 16,384 words and word lengths up to 48 bits. Manufacturer: Rese Engineering, Inc., "A" and Courtland Streets, Philadelphia 20, Pa.

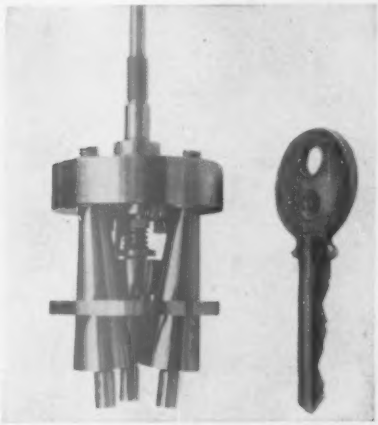


• **Microminiature resistor,** wire-wound, measuring only 1/16 x 1/16 in., is available in resistances of 1 to 50,000 ohms with power ratings of 0.02 watts. Manufacturer: Reon Resistor Corp., 155 Saw Mill River Road, Yonkers, N. Y.

• **Transistorized UHF/VHF beacon** transmitter, Model BT-201, for air-sea rescue use, weighs only 1¾ lb., measures approximately 5½ x 3¼ x 1¼ in. Power output is 250 mw. at 121.5 mc.

or 243 mc. Transmitter, which is crystal controlled, is modulated Class A2 by a 1,400 cps. tone, approximately three pulses per second. Manufacturer: General Antronics Corp., 11930 W. Jefferson Blvd., Culver City, Calif.

• **Miniature synchro with sector switch** automatically actuates switch and closes circuit when synchro rotor is positioned 70 deg. (or other desired value) from its electrical zero. The switching capability adds only 0.5 in. to length of Size 8 synchro. Device weighs 2 oz., measures 0.75 in. dia. x 1.7 in. long. Manufacturer: Clifton Precision Products, 5050 State Road, Drexel Hill, Pa.



• **Miniature variable-speed transmission,** measuring 2 x 2½ x 3¾ in., is a compound planetary system with the nonrotating member a traction ring that engages tapered rollers at varying diameters. Capable of handling up to ⅛ hp., device is available in three types: one delivers all speeds from any desired maximum down to zero; a second delivers speeds from maximum to zero and full reverse without change of input rotation. The third can be connected to give output speeds that vary approximately 10% from a given input speed. Manufacturer: Graham Transmissions, Inc., Menomonee Falls, Wis.

• **UHF germanium transistor,** Type 2N700A, capable of oscillating at frequency above 1,000 mc. is designed to meet MIL-S-19500/123. The diffused-base mesa transistor operates at 25 volts and has a 75 mw. free-air rating. Manufacturer: Motorola Semiconductor Products, Inc., Phoenix, Ariz.

MAN INTO SPACE!

We are proud that the epoch-making success of National Aeronautics and Space Administration's first launching of man into space depended, in part, upon guidance and control system components under contract to the Ford Instrument Company–and that this confidence was justified by the event.

FORD INSTRUMENT CO.
DIVISION OF SPERRY RAND CORPORATION
31-10 Thomson Avenue, Long Island City 1, New York

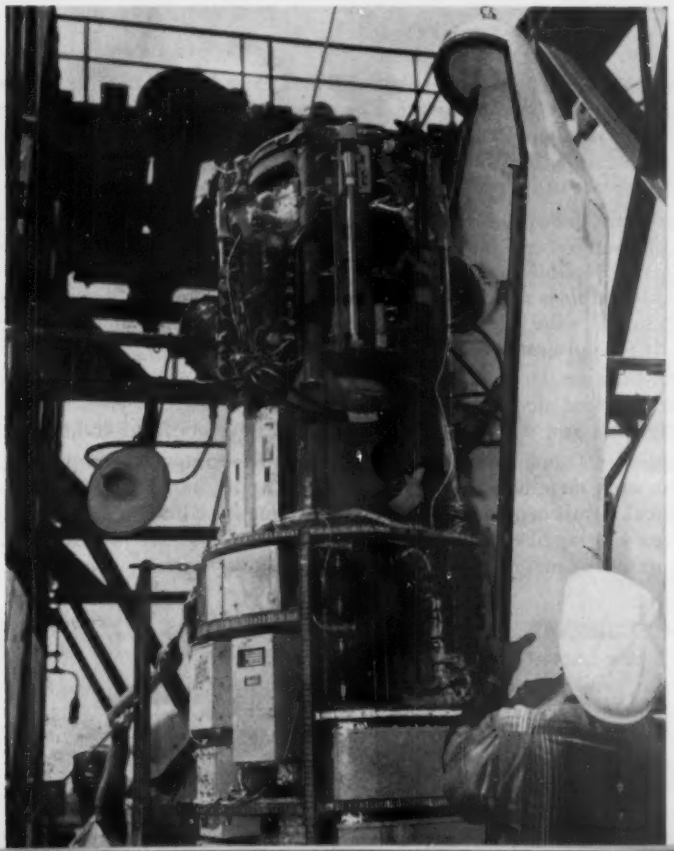
Other missile and space "firsts" in which Ford Instrument guidance and control components participated: • First operational ballistic missile (REDSTONE) • First successful launching of a Free-World satellite • First successfully recovered nose cone • First recovered simian passengers (Able and Baker) • First successful Free-World space probe • First MERCURY-REDSTONE space vehicle (chimpanzee, Ham). 1.2

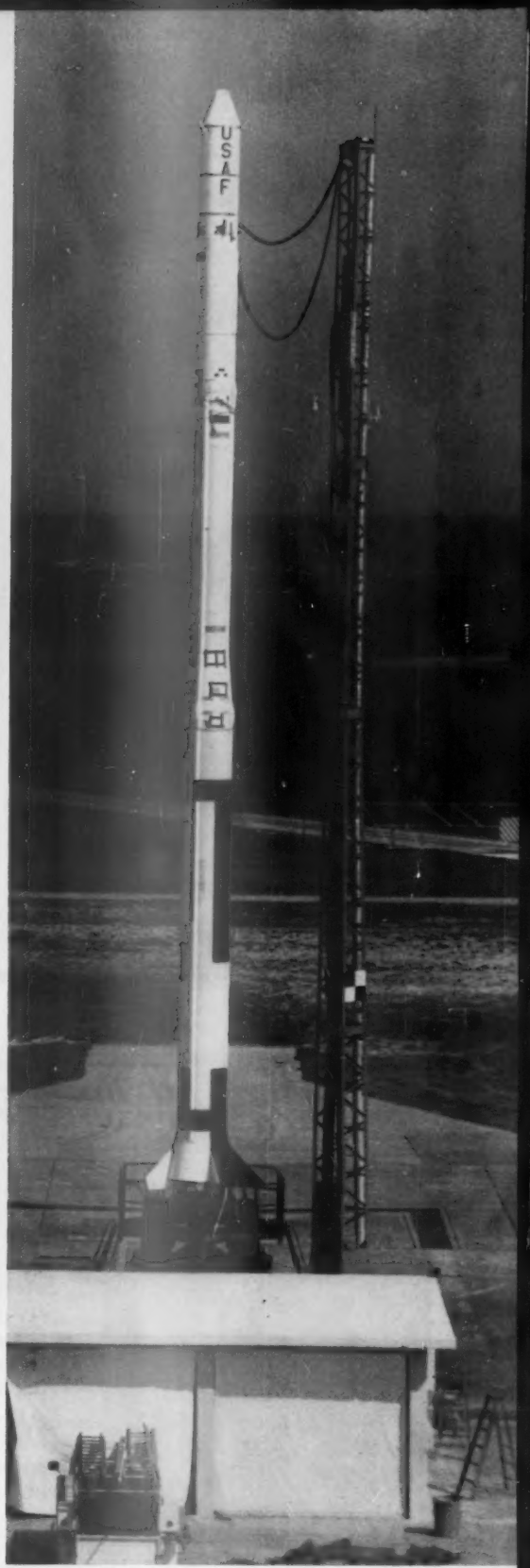
A CREATIVE TEAM OF SCIENTIFIC, ENGINEERING AND PRODUCTION TALENT

Data-gathering equipment of the Blue Scout is checked at Aeronutronic Division of Ford Motor Co.'s Newport Beach, Calif., facility, before being mounted on upper section of vehicle. Aeronutronic is prime contractor for Blue Scout.

Blue Scout Gathers Space Data

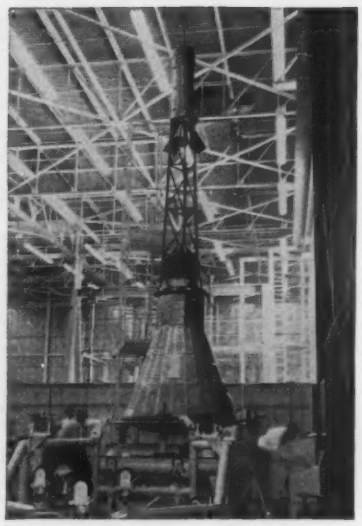
Blue Scout II research vehicle launched by Air Force personnel carried geophysical experiment packages. Recoverable capsule was lost, but data from five instruments was telemetered to ground stations. Below, Air Force personnel place heat shields on nose section.





Blue Scout II four-stage Air Force space probe is shown on launch pad at Cape Canaveral, Fla. Vehicle was launched Apr. 12 (AW Apr. 17, p. 37) but 90-lb. recoverable capsule was lost.

WITH MAN IN SPACE



McDONNELL AIRCRAFT CORPORATION, Lambert Field, St. Louis, Missouri, is prime contractor for the Mercury Capsule, under the direction of the National Aeronautics and Space Administration. Photo shows capsule similar to the FREEDOM VII used in successful launch.

The time: May 5, 1961, 10:34 AM, EDT. *The man:* Commander Alan B. Shepard, Jr., USN, Astronaut. *The event:* launching of the Mercury Capsule with man on a down range step into space. *The metal:* titanium for a combination of strength and lightweight in the vehicle's double wall stringer construction.

A major supplier of commercially pure AMS4901 titanium in the Mercury Project, Republic Steel is the nation's *largest* producer of high-performance metals. Republic is a new source of a complete line of precipitation hardenable stainless steels . . . the only source of continuous rolled stainless sheet up to 60″ wide . . . the largest producer of stainless and alloy steels, and steels for cold extrusion.

To meet the challenge of space, Republic Steel is looking deep into the microstructure of steel . . . pulling facts from the heart of steel . . . aiming at fantastic new steels with tensile strengths even beyond 400,000 psi.

Republic's 3-Dimensional metallurgical teams—composed of mill, field, and laboratory metallurgists—help you select, apply, and process the most economical metals capable of meeting requirements. This is a confidential, obligation-free service. For additional information, contact your Republic representative or mail the coupon on the opposite page.

DESIGN ENGINEERS: Mail the coupon for a copy of Republic's new booklet, *Products For The Design Engineer.* Contains a useful Stainless Steel Selector Chart, and information on Republic High Strength Steels, Titanium, Electrical Steels, Vacuum Arc Melted Steels, and other high performance metals.

VACUUM ARC MELTED METALS . . .

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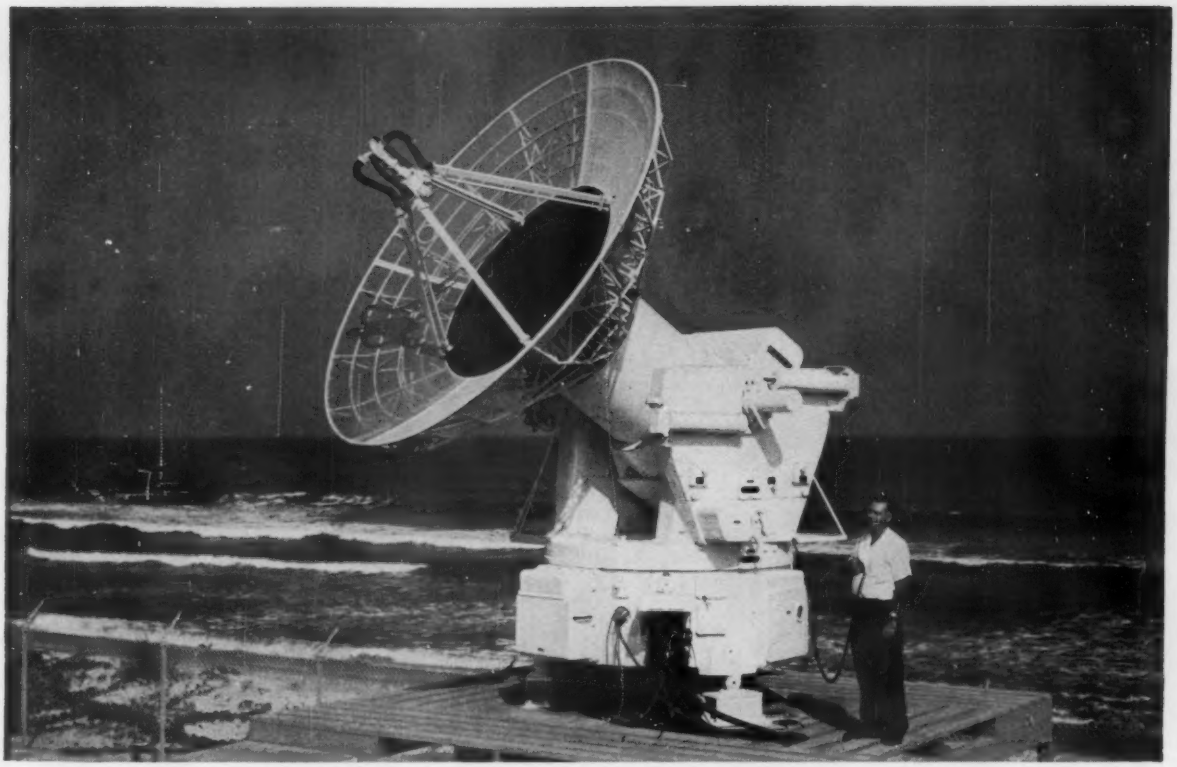

RCA proudly salutes the history-making Man of Mercury

The nation views with pride and with satisfaction, the outstanding achievement of the National Aeronautics and Space Administration and the United States Air Force in successfully executing Commander Alan B. Shepard's history-making flight through space.

The RCA Service Company appreciates the opportunity to have been a vital partner in this national achievement by providing Range Instrumentation Support and operating the Tracking Facilities at the Atlantic Missile Range since 1953.

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Airlines Report Officers' Compensation

Washington—Following is a list of airline officers' salaries, bonuses and indirect compensation, expenses, and stock holdings for the year ending Dec. 31, 1960, as filed with the Civil Aeronautics Board:

Continental Airlines—R. F. Six, president and director, $68,333 salary, 5,250 shares of common stock, $32,604 expenses; **H. L. Lawrence, executive vice president** and director, $36,807 salary, 1,125 shares of common stock, $3,456 expenses; **A. Damm** vice president-finance, $28,333 salary, no stock, $3,456 expenses; **H. W. Bell, Jr.,** vice president-personnel, $18,100 salary, 161 shares of common stock (held jointly with **L. H. Bell**), $5,520 expenses; **C. A. Bucks,** assistant vice president-sales from May 1, 1960, $10,000 salary, no stock, $3,742 expenses; **H. B. Cady,** assistant vice president-treasurer, $14,333 salary, no stock, $307 expenses; **C. H. Calhoun** vice-president-engineering and maintenance $22,073 salary, 210 shares of common stock, $3,056 expenses; **F. G. Colnar,** assistant vice president-budget director, $13,253 salary, 63 shares of common stock, $2,234 expenses.

M. L. Davis, vice president-sales, $19,667 salary, 50 shares of common stock, $2,478 expenses; **O. R. Haueter,** vice president-operations, $27,000 salary, 2,172 shares of common stock (held jointly with **Wilma Haueter**), $3,424 expenses; **G. J. Kelly,** secretary, $12,500 salary, 855 shares of common stock, $776 expenses; **B. King,** assistant vice president-publicity (from May 1, 1960), $10,667 salary, 1,000 shares of common stock, $1,049 expenses; **M. Kramer,** vice president-customer service planning, $19,553 salary, 1,475 shares of common stock, $3,501 expenses; **P. F. Kriethe,** assistant secretary, $12,800 salary, five shares of common stock, $1,470 expenses; **E. B. Banes,** vice president-customer field service, $17,140 salary, no stock, $2,708 expenses.

S. B. Redmond, vice president-regulatory proceedings $17,953 salary, 1,243 shares of common stock, $2,681 expenses; **R. G. Schorling,** assistant vice president-purchasing, $15,720 salary, 168 shares of common stock, $2,400 expenses; **C. F. Whelan,** vice president-economic planning, $19,667 salary, no stock, $1,143 expenses; **D. R. Wilson,** vice president-flight, $19,765 salary, no stock, $1,724 expenses; **L. H. Dennis,** vice president-customer service plan, (until Jan. 15, 1960) $843 salary, 945 shares of common stock, expenses.

L. H. Mueller, chairman of the board, no salary, 25,595 shares of common stock, no expenses, $200 bonus and indirect compensation, $24,000 debt securities; **L. C. Ames,** director, no salary, 7,200 shares of common stock, $1,009 expenses, $400 bonus and indirect compensation, $60,000 debt securities; **A. O. Beckman,** director, no salary, 420 shares of common stock, $237 expenses, $300 bonus and indirect compensation; **S. G. Cooper,** director, no salary, 2,625 shares of common stock (held jointly with **Patricia Cooper**), $208 expenses, $300 bonus and indirect compensation.

E. L. Ehrman, director, no salary, 4,135 shares of common stock, no expenses, no bonus or indirect compensation; **M. F. Hellman,** director, no salary, 11,025 shares of common stock in the name of others, no expenses, $100 bonus and indirect compensation; **L. D. Henry,** director, no salary, 200 shares of common stock, $1,362 expenses, $300 bonus and indirect compensation; **J. G. Holland,** director, no salary, 3,255 shares of common stock, no expenses, $500 bonus and indirect compensation, $5,000 debt securities; **W. P. Paepcke,** director, (deceased, 1960,) 2,100 shares of common stock; **F. H. Ricketson,** director, no salary, 6,090 shares of common stock, no expenses, $300 bonus and indirect compensation.

R. J. Smith, director, no salary, 225 shares of common stock, $367 expenses, $300 bonus and indirect compensation, $30,000 debt securities; **R. Stewart,** director, no salary, 105 shares of common stock, $325 expenses, $300 bonus and indirect compensation; **J. A. Uhl,** director, no salary, 5,373 shares of common stock, $199 expenses, $400 bonus and indirect compensation; **J. A. Pritzker,** director, (from Apr. 25, 1960) no salary, 16,300 shares of common stock in the name of others, no expenses, $100 bonus and indirect compensation; **D. A. Kimball,** director, (from July 29, 1960) no salary, stock, expenses, bonus or indirect compensation.

Following firms were paid for services rendered during 1960: **Peat, Marwick, Mitchell & Co.,** audit, $53,581; **J. Walter Thompson,** advertising, $2,295,485; **Cooper, White & Cooper,** legal, $53,581; **Holland & Hart,** legal, $59,800; **Leasure, Scheurer & Carter,** legal, $62,427; **Gibson, Dunn & Crutcher,** legal, $30,607; **Patterson, Belknap & Famer** legal, $19,940; **Charles Butler & Associates,** consultants, $12,313; **Hoff, Canny, Bonen & Associates,** consultants, $11,143; **H. Golightly,** consultants, $8,183; **McKinsey & Co., Inc.,** consultants, $5,504.

Planning Research Corp., consultants, $6,780; **Cross, Murray & Smith,** consultants, $29,151; **American Express Co.** commissions, $16,728; **Boulder Travel Agency,** commissions, $7,369; **University Travel,** commissions, $6,745; **Boulder Travel,** commissions, $6,344; **Guide Travel System,** commissions, $9,614; **World Wide Travel System,** commissions, $9,210; **Dyal Travel,** commissions, $5,365; **Travel Service Everywhere,** commissions, $14,757; **Lones Travel,** commissions, $13,600; **MacDonald Travel,** commissions, $6,294.

Delta Air Lines

Delta Air Lines, Inc.—**C. E. Woolman,** president-general manager, $60,000 salary, 41,196 shares of common stock, $3,260 expenses; **T. G. Cole,** executive vice president-administration and assistant secretary, director, $36,000 salary, 841 shares of common stock, $476 expenses; **C. H. Dolson,** executive vice president-operations and director, $36,000 salary, 1,625 shares of common stock and 187 shares in the name of others, $1,026 expenses; **R. S. Maurer,** vice president-legal, $23,750 salary, 113 shares of common stock, $2,329 expenses; **W. T. Beebe,** vice president-personnel, $25,000 salary, 187 shares of common stock, $842 expenses.

Erle Cocke, Jr., vice president-civic affairs, $19,400 salary, 1,700 shares of common stock and 51 shares in the name of others, $4,008 expenses; **T. M. Miller,** vice president-traffic & sales, $25,000 salary, 70 shares of common stock, $2,426 expenses; **R. L. Griffith,** vice president, $20,417 salary, 100 shares of common stock, $4,508 expenses; **R. Oppenlander,** comptroller-treasurer, $19,200 salary, no stock, $306 expenses; **R. H. Wharton,** assistant vice president-personnel, $16,000 salary, 250 shares of common stock, $602 expenses; **C. H. McHenry,** secretary-treasurer, director, (deceased), $250 salary, 1,875 shares of common stock, $95 expenses.

C. Fitzgerald assistant treasurer, $7,000 salary, 4,225 shares of common stock, no expenses; **H. H. Saxon,** assistant treasurer, $12,000 salary, no stock, $165 expenses; **J. R. Howell,** assistant treasurer, $12,000 salary, no stock, $46 expenses; **C. B. Wilder,** assistant vice president-operations, technical, $18,500 salary, 150 shares of common stock, $202 expenses; **P. W. Pate,** assistant vice president-properties, $14,400 salary, 100 shares of common stock, $2,309 expenses; **C. P. Knecht,** assistant vice president-sales, $14,400 salary, 272 shares of common stock, $695 expenses.

R. W. Freemenan, chairman of the board, $1,200 salary, 8,050 shares of common stock, $6,000 expenses; **R. W. Courts,** director, no salary, 100 shares of common stock, $24 expenses; **E. H. Gerry,** director, no salary 1,175 shares of common stock, $37 expenses; **J. R. Longmire,** director, no salary, 2,500 shares of common stock and 2,109 shares in the name of others, $194 expenses.

W. Nunnally, director, no salary, 13,000 shares of common stock, no expenses; **C. Putnam,** director, no salary, 7,500 shares of common stock in the name of others, no expenses; **E. Flinn,** director, no salary, 100 shares of common stock, no expenses; **J. W. Rodgers,** director, no salary, 1,000 shares of common stock, $24 expenses; **G. M. Snelling,** director, no salary, 100 shares of common stock, no expenses.

Following firms were paid for services rendered during 1960: **Chapman, Walsh and O'Connell,** legal, $61,016; **Arthur Andersen & Co.,** audit, $18,466; **Pogue and Neal,** legal, $15,039; **Alvord and Alvord,** legal, $12,010; **Turner, Rodgers, Winn, Scurlock & Terry,** legal, $6,005; **Lazo and Cubas,** legal, $5,956.

Eastern Air Lines

Eastern Air Lines—E. V. Rickenbacker, chairman of the board, $50,000 salary, 54,649 shares of common stock, $7,649 expenses, $900 bonus and indirect compensation; **M. A. MacIntyre,** president and director, $80,000 salary, 102 shares of common stock, $5,269 expenses, $900 bonus and indirect compensation; **T. F. Armstrong,** executive vice president and director, $35,000 salary, 6,337 shares of common stock, $2,851 expenses, $900 bonus and indirect compensation; **T. E. Creighton,** treasurer and director, $19,792 salary, 4,850 shares of common stock, $400 expenses, $600 bonus and indirect compensation; **M. M. Frost,** vice president, $28,600 salary, 2,260 shares of common stock, $8,488 expenses;

W. Van Dusen, vice president, $26,375 salary, 3,316 shares of common stock, $4,263 expenses; **C. Froesch,** vice president, $23,542 salary, 2,620 shares of common stock, $2,634 expenses; **J. H. Brock,** $24,417 salary, 2,165 shares of common stock, $4,005 expenses; **M. Lethbridge,** $18,834 salary, 553 shares of common stock, $1,562 expenses; **W. L. Morrisette, Jr.,** $24,792 salary, 454 shares of common stock, 3,605 expenses; **R. L. Turner,** vice president (from Mar. 1, 1960), $25,792 salary, 102 shares of common stock, $6,253 expenses; **R. Ramspeck,** vice president, $20,000 salary, 770 shares of common stock, $3,610 expenses.

A. L. Chabot, vice president, $26,250 salary, 1,062 shares of common stock, $5,427 expenses; **G. A. Smith,** vice president, $25,000 salary, 3,331 shares of common stock, $4,734 expenses; **J. H. Halliburton,** vice president $30,125 salary, 686 shares of common stock, $3,332 expenses; **R. S. Lipp,** secretary, $13,950 salary, 301 shares of common stock, $424 expenses; **C. R. Springer,** deputy vice president (from Sept. 1, 1960), $11,898 salary, no stock, $1,179 expenses; **R. F. Moore,** deputy vice president (from Aug. 15, 1960), $8,063 salary, no stock, $1,694 expenses; **M. B. Westphal,** assistant vice president, $18,309 salary, 160 shares of common stock, $2,929 expenses.

H. W. Cutshall, assistant vice president,

Exhaust Covers Developed for Turbofans

Tail and fan bypass exhaust covers for Boeing 707 and Douglas DC-8 turbofan engines have been developed to protect the engines against ingestion of foreign elements. The exhaust covers, which are also used in jet engine tear-down and build-up and during routine maintenance, were developed by Thermo-Plastic Products Co., Inc., San Carlos, Calif.

$13,375 salary, 11 shares of common stock, $3,209 expenses; **F. Sharpe**, assistant vice president, $19,121 salary, 569 shares of common stock, $2,914 expenses; **R. E. Baskind, assistant vice president**, $15,000 salary, 167 shares of common stock, $3,205 expenses; **M. O. Byrd**, assistant vice president, $14,800 salary, 55 shares of common stock, $2,943 expenses; **L. O. Cameron**, assistant vice president (from Feb. 26, 1960), $15,069 salary, 823 shares of common stock, $1,175 expenses; **G. W. Channel**, assistant vice president, $14,875 salary, no stock, $3,826 expenses; **P. L. Foster**, $28,640 salary, 203 shares of common stock, $1,022 expenses.

W. C. Gilbert, assistant vice president (from Jan. 29, 1960), $15,209 salary, 663 shares of common stock, $1,295 expenses; **C. A. Glover**, assistant vice president, $15,000 salary, 423 shares of common stock, $4,729 expenses; **B. Griffith**, assistant vice president, $9,317 salary, no stock, $2,094 expenses; **J. A. Hamill**, assistant vice president, $12,000 salary, 15 shares of common stock, $323 expenses; **J. T. Hoffman**, assistant vice president, $12,309 salary, 116 shares of common stock, $4,075 expenses; **J. O. Jarrard**, assistant vice president (from Jan. 25, 1960), $19,802 salary, no stock, $1,657 expenses.

H. Knapp, assistant vice president, $12,000 salary, 355 shares of common stock, $3,557 expenses; **D. C. McRae**, assistant vice president, $16,804 salary, 742 shares of common stock, $1,351 expenses; **J. E. Reinke**, $14,550 salary, 103 shares of common stock, $3,682 expenses; **D. L. Sinkler**, $13,700 salary, 570 shares of common stock, $4,484 expenses; **T. A. Sundem**, assistant vice president, $14,750 salary, 32 shares of common stock, $3,519 expenses; **A. F. Tirrell**, assistant vice president, $12,317 salary, 195 shares of common stock, $3,785 expenses; **E. L. Williams**, assistant vice president, $12,500 salary, 223 shares of common stock, $6,107 expenses; **F. E. Williams**, assistant vice president, $15,017 salary, 378 shares of common stock, $4,776 expenses.

W. T. Raymond, assistant vice president, $14,375 salary, no stock, $11,575 expenses; **H. C. Dobbs**, assistant vice president $12,000 salary, 301 shares of common stock, $1,307 expenses; **E. E. Hahn**, assistant treasurer, $13,550 salary, 157 shares of common stock, $1,087 expenses; **C. J. Simons**, assistant treasurer, $13,392 salary, 234 shares of common stock and 58 shares in the name of others, $2,382 expenses; **J. C. Warlick**, assistant secretary, $10,550 salary, 459 shares of common stock, $664 expenses; **C. A. Wallen**, assistant secretary, $12,892 salary, 306 shares of common stock, $983 expenses.

E. R. Cook, director, no salary, 611 shares of common stock, no expenses, $400 bonus and indirect compensation; **C. E. Daniel**, director, no salary, 1,030 shares of common stock, $400 bonus and indirect compensation; **P. M. Davis**, director, no salary, 3,091 shares of common stock, no expenses, $100 bonus and indirect compensation; **J. A. Elkins**, director, no salary, 312 shares of common stock, no expenses, $400 bonus and indirect compensation; **G. B. Howell**, director, no salary, 1,657 shares of common stock, no expenses, $400 bonus and indirect compensation; **H. Knowlton**, director, no salary, 534 shares of common stock in the name of others, no expenses, $700 bonus and indirect compensation.

P. E. Reinhold, director, no salary, 1,658 shares of common stock and 6,367 shares in the name of others, no expenses, $700 bonus and indirect compensation; **L. S. Rockefeller**, director, no salary, 93,636 shares of common stock, no expenses, $300 bonus and indirect compensation; **M. Smith**, director, 553 shares of common stock, no expenses, $500 bonus and indirect compensation; **F. J. Turner**, director, no salary, 327 shares of common stock, no expenses, $500 bonus and indirect compensation; **C. H. Kellstadt**, director, no salary, no stock, no expenses, $100 bonus and indirect compensation.

Following firms were paid for service rendered during 1960: **Gambrell, Harlan, Russell, Moye and Richardson**, legal, $264,807; **C. Moon**, consultant, $6,400; **Price, Waterhouse & Co.**, audit, $18,385; **Gus W. Campbell Associates**, consultants, $12,000; **Smith Barney & Co.**, Eastern common stock employe award plan, $41,628; **Wyatt, Grafton & Sloss**, legal, $10,373; **Desmond & Lord**, plans and specifications for Chicago hangar, $5,357; **Record Press**, printing and filing, $15,688; **L. P. Arnold**, consultant, $6,000; **P. H. Brattan**, consultant, $12,000.

National Airlines—**G. T. Baker**, president and director, $60,000 salary, 169,973 shares of common stock, $12,557 expenses; **J. C. Brawner**, executive vice president and director, $30,000 salary 3,992 shares of common stock, $1,088 expenses; **W. B. Caldwell, Jr.**, assistant treasurer, $12,000 salary, 78 shares of common stock, $716 expenses; **J. W. Colthar**, assistant vice president, $15,000 salary, no stock, no expenses; **R. Drake**, treasurer, $12,000 salary, no stock, $189 expenses; **L. W. Dymond**, vice president, $24,000 salary, 659 shares of common stock, $1,068 expenses; **R. A. Fitzgerald**, vice president, $15,000 salary, 136 shares of common stock, $1,444 expenses.

R. P. Foreman, secretary and director (until Feb. 29, 1960), $2,500 salary, no stock, $30 expenses; **R. S. Grant**, assistant vice president, $15,000 salary, 102 shares of common stock, $451 expenses; **A. G. Hardy**, senior vice president, $24,000 salary, 2,755 shares of common stock, $3,699 expenses; **W. F. Johnston**, vice president, $18,000 salary, 2,996 shares of common stock, $641 expenses; **J. L. Morris**, $18,000 salary, 3,957 shares of common stock, $4,470 expenses; **G. W. Paul**, assistant vice president, $10,583 salary, three shares of common stock, $663 expenses;

J. M. Rosenthal, senior vice president, $24,000 salary, 2,922 shares of common stock, $648 expenses; **C. F. Sharp**, vice president, $18,000 salary, 1,301 shares of common stock, $2,473 expenses; **J. D. Bassage**, vice president (until Jan. 20, 1960), $1,075 salary, no stock, no expenses; **H. B. Taylor**, assistant treasurer, $10,000 salary, no stock, $1,503 expenses; **R. E. Wieland**, vice president, $18,000 salary, 4,087 shares of common stock, $3,829 expenses; **A. L. Stanley**, assistant vice president, $9,000 salary, 106 shares of common stock, $248 expenses; **N. M. Paquette**, assistant corporate secretary (from Feb. 6, 1960), $5,811 salary, no stock, $29 expenses;

The following directors received no salary, expenses or bonus and indirect compensation during 1960: **J. W. Cross**, 3,671 shares of common stock; **G. W. Gibbs, Jr.**, 82 shares of common stock; **A. L. Mc Carthy**, (from Nov. 4, 1960) 2,095 shares of common stock; **E. C. McDonald**, 16 shares of common stock; **A. G. McNeese**, 150 shares of common stock; **P. R. Scott**, 2,080 shares of common stock; **D. R. Topping**, 1,097 shares of common stock; **J. A. Waterman**, 662 shares of common stock; **B. Winters**, no stock.

Following firms were paid for services rendered during 1960: **Alexander & Alexander**, actuarial services, $9,609; **Marschalk-Pratt**, advertising, $1,908,797; **Cross, Murphy & Smith**, legal, $47,819; **Denning & Whohlstetter**, legal, $5,555; **Hank Meyer Associates**, public relations, $15,632; **Scott, McCarthy, Preston, Steel & Gilleland**, legal, $38,633; **Ernst & Ernst**, management consultants, $41,694; **Communications Counselors, Inc.**, public relations, $11,193; **Johns Hopkins**, medical services, $5,747; **Wenchell, Schulman & Manning**, legal, $13,179; **Investigators, Inc.**, management research, $5,076; **Public Relations Aids, Inc.**, public relations, $10,716; **Haskins & Sells**, audit, $12,313; **Sales Communications**, advertising, $73,277.

Northeast Airlines—**J. W. Austin**, president, $36,000 salary, 200 shares of common stock, $5,082 expenses; **J. S. Daniels**, assistant vice president advertising-promotion, $14,400 salary, 200 shares of common stock, $1,309 expenses; **N. B. Fry**, vice president-traffic and sales (until Feb. 29, 1960), $4,179 salary, no stock, $811 expenses; **T. L. Grace**, vice president-operations, $25,000 salary, no stock, $1,574 expenses; **H. Heard**, vice president-administration, $15,000 salary, no stock, $520 expenses; **R. P. Lane, Jr.**, vice president-finance and treasurer, $20,000 salary, no stock, $2,026 expenses.

W. W. Mies, assistant vice president-quality control, $12,000 salary, 100 shares of common stock, $321 expenses; **M. W. Offutt, III**, assistant vice president, general

KNOW YOUR ALLOY STEELS . . .

This is one of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many who may find it useful to review fundamentals from time to time.

Steel *for Strength . . . Economy . . . Versatility*

Flame-Hardening Alloy Steels

The process known as flame-hardening involves the direct application of flame to the surface of steel, heating it above the transformation range, then hardening it by quenching. The primary purpose of this process is to achieve surface-hardness without affecting core properties. Jets of flame are played directly on the steel, and hardness penetration can be made to vary considerably. In alloy steels this depth will range usually from 0.03 to 0.12 in., the actual figure depending upon the method of heating and quenching used.

Unlike carburizing, flame-hardening does not involve the absorption of extraneous elements by the steel. There is no alteration of the chemical composition. To put it simply, the steel must have its own self-hardening characteristics; it cannot be dependent upon carbonaceous salt baths, gases, and other media.

Flame-hardening is not a substitute for the conventional furnace method. Each has its uses. The particular virtue of flame-hardening is that the flames can be directed to localized areas. The furnace, on the other hand, is generally more economical and feasible when parts produced in large quantities must be hardened all over.

Any type of hardenable steel, alloy or carbon, can be flame-hardened, and there will usually be no scale or pitting. The alloy content is the governing factor when determining the quench. In some cases a rapid quench is required; in others, it can be as slow as air-cooling. Tempering presents no problems, for flame-hardened steel can be tempered as if hardened to the same degree by other methods.

A list of typical flame-hardened parts includes such familiar items as gear and sprocket teeth, and certain types of cams and rollers, and shoe treads. A complete list would include many other parts that often require a localized hardening treatment, especially for wear-resistance.

When you need information about flame-hardening methods, please feel free to consult with our technical staff. Bethlehem metallurgists will work with you, at no obligation, and you can depend on their suggestions. You can rely on Bethlehem, too, as a source of alloy steels . . . for Bethlehem makes the complete range of AISI standard grades, as well as special-analysis steels, and all carbon grades.

This series of alloy steel advertisements is now available as a compact booklet, "Quick Facts about Alloy Steels." If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

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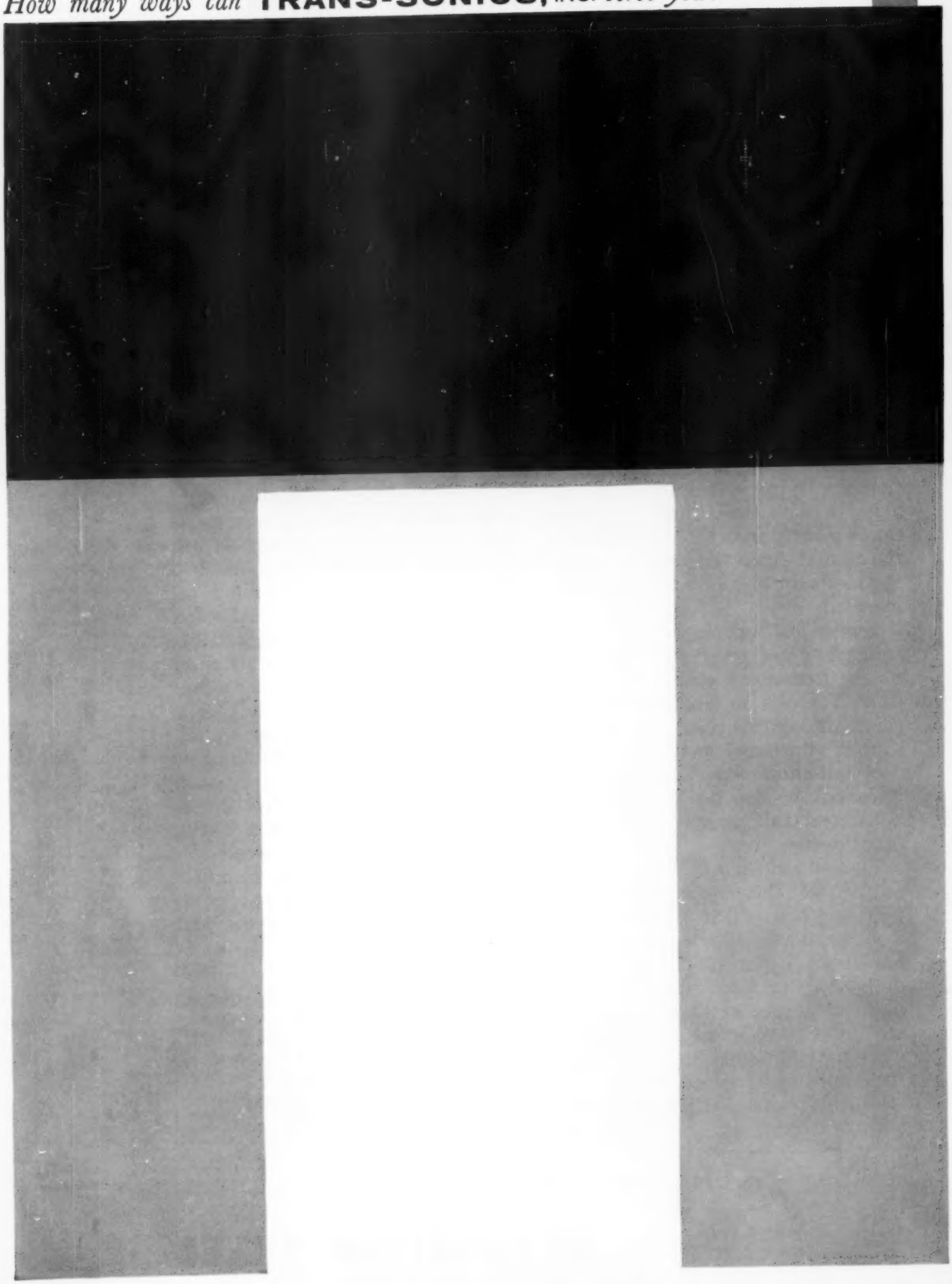

Engineers and scientists at Convair/Astronautics enjoy not only the immeasurable rewards of participating in the development of this nation's most advanced space systems, but the added bonus of living and raising their families in resort-like San Diego, California. San Diego's climate is near-perfect, and its ideal location permits almost any sort of family recreation the year around. Indeed, on the first day of summer last year, the temperature was 78 degrees; on the first day of winter, 76. Schools are excellent and uncrowded; cultural attractions abundant; advanced educational facilities are constantly being expanded.

If you are an experienced engineer or scientist with a creative approach, we'd like to tell you more about our company, our community, and how they might fit into your future. You'll find more information on the back of this page, and a convenient inquiry card which will receive immediate and confidential attention. Why not mail it today? No obligation, of course.

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ENGINEERING PLACEMENT INQUIRY

This card may be folded and sealed or stapled and mailed in complete confidence. It will enable the professional staff at Convair/Astronautics to make a preliminary evaluation of your background. A personal interview can be arranged in your city by appointment. Every completed inquiry will be acknowledged.

NAME_____

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NEAREST MAJOR CITY (IF APPLICABLE)_____

COLLEGE GRADUATE: YES ☐ NO ☐ DEGREE: BS ☐ YR____ MS ☐ YR____ PHD ☐ YR____

MAJOR SUBJECT:

AERONAUTICAL ENGINEERING	☐	MECHANICAL ENGINEERING	☐
ELECTRICAL ENGINEERING	☐	MATHEMATICS	☐
ELECTRONIC ENGINEERING	☐		
CIVIL ENGINEERING	☐	PHYSICS	☐

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EXPERIENCE:

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SECONDARY SPECIALTY_____ YRS_____

ADDITIONAL COMMENTS, IF ANY, CONCERNING YOUR JOB INTERESTS:

PLEASE SEND CONVAIR/ASTRONAUTICS RECRUITMENT BROCHURE: AW-5 ☐

If the inquiry card has been removed, or if you wish to furnish or request more detailed information, please write to Mr. R. M. Smith, Industrial Relations Administrator-Engineering, Mail Zone 30-90, Convair/Astronautics, 5669 Kearny Villa Road, San Diego 12, California. If you live in the New York area, please contact Mr. T. Cozine, manager of our New York placement office, CIrcle 5-5034.)

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CONVAIR/ASTRONAUTICS
POST OFFICE BOX 1128
SAN DIEGO 12, CALIFORNIA

PERSONAL AND CONFIDENTIAL
ATTENTION: MR. R. M. SMITH
MAIL ZONE 130-90

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ENGINEERS AND SCIENTISTS

tronautics is located in San Diego, Cali- third fastest growing community in the es. It is situated 10 miles north of the order and a little over 100 miles south eles.

openings exist in the following areas:

S & ANALYTICAL ENGINEERS with Ph.D electronics and physical research; com- sis and application; and instrumentation t.

IC DESIGN & TEST: communication sys- ta transmission design; logical circuitry; ontrol systems; and electronic packaging. appropriate experience required.

AL DESIGN: BSME or AE for pneumat- ics, and fluid systems design and test. GSE and missile structures designers.

Y: BSEE, ME, or AE to perform relia- es and test both in San Diego and offsite

L SYSTEMS (MAN/MACHINE ANALY- ists capable of evaluating the personnel n a systems standpoint. Requires analyti- n to applying manpower to an existing customer level. Broad technical systems with emphasis on human relations is signments involve analysis of manpower requirements and applications for a weapon system, including equipment, procedures, time studies, logistics and training. Degree required, preferably in industrial engineering, business administration or industrial psychology.

ENGINEERING WRITERS with 2 years college and 3 years experience in preparation of TCTO's; Operations, Maintenance, and Overhaul manuals.

GUIDANCE SYSTEM ANALYSTS to define the optimum characteristics, philosophy, and mode of operation of sophisticated guidance systems of extreme accuracy. A Ph.D degree plus experience in guidance systems and missile simulation is desired, but more extensive experience in related fields will be favorably considered.

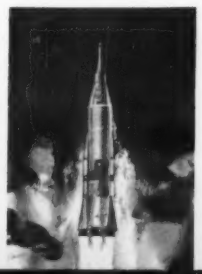
PRE-DESIGN ENGINEERS with experience in proposal preparation and system design of guidance and tracking systems.

If you desire to become part of this great team, we urge your prompt inquiry on the attached Engineering Placement Inquiry.

Technical openings also exist in other specialties. Write Mr. R. M. Smith, Industrial Relations Administrator-Engineering, Dept. 130-90, Convair Astronautics, 5669 Kearny Villa Road, San Diego 12, California. (If you live in the New York area, please contact Mr. T. Cozine, manager of our New York placement office, CIrcle 5-5034.)

ALL QUALIFIED APPLICANTS WILL RECEIVE CONSIDERATION FOR EMPLOYMENT WITHOUT REGARD TO RACE, CREED, COLOR, OR NATIONAL ORIGIN.

R/ASTRONAUTICS



CONVAIR DIVISION OF GENERAL DYNAMICS

sales manager, $16,881 salary, no stock, $3,024 expenses; **E. O. Schroeder**, vice president-technical services, $25,000 salary, 200 shares of common stock; **A. S. Walker, Jr.**, vice president-ground operations, $14,400 salary, no stock, no expenses; **H. F. Zimmerman**, assistant treasurer, $14,000 salary, no stock, $176 expenses.

The following directors received no salary, expenses, or bonus and indirect compensation during 1960; **Jacqueline Cochrane**, 1,000 shares of common stock; **P. F. Collins**, 100 shares of common stock; **J. F. Fitzgerald**, 500 shares of common stock; **B. Irimescue**, (from Sept. 14, 1960), no stock; **A. G. McMeninen**, 300 shares of common stock; **D. A. Stretch**, chairman, 600 shares of common stock; **E. L. Vidal**, 13,000 shares of common stock; **L. F. Whittemore**, (until Sept. 14, 1960), no stock; **G. E. Gardner**, $21,000 salary, 100 shares of common stock, no expenses.

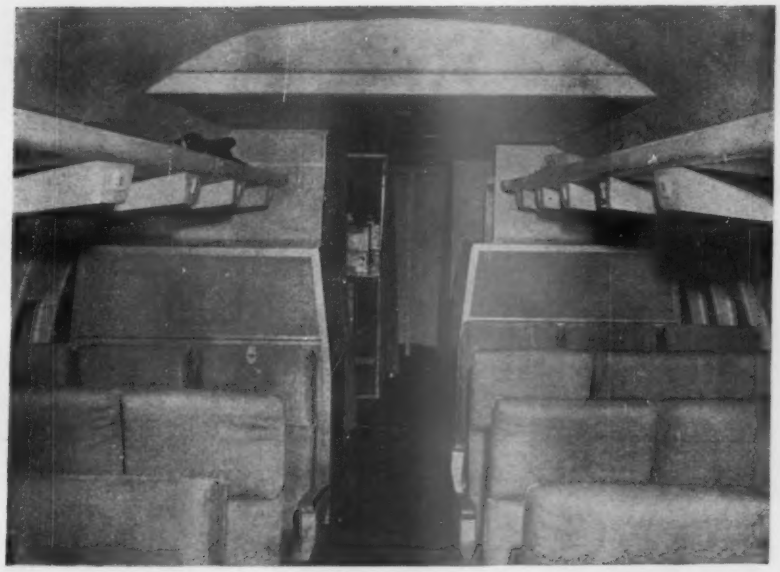
Following firms were paid for services rendered during 1960: **J. Walter Thompson**, advertising, $1,742,389; **Airline Architectural Consultants**, architectural services, $18,924; **Lybrand, Ross Bros. & Montgomery**, audit, $25,195; **Foley, Hoag & Eliot**, legal, $87,170; **Walton, Lantaff, Schroeder, Atkins, Carson & Wahl**, legal, $9,683.

Northwest Airlines—**D. W. Nyrop**, director and president, $75,000 salary, 14,900 shares of common stock, $7,253 expenses; **F. C. Judd**, vice president-maintenance and station operations, $33,000 salary, 1,005 shares of common stock, $3,670 expenses; **E. T. Nunneley, Jr.**, vice president and general counsel (from Sept. 26, 1960), $7,125 salary, no stock, $742 expenses; **P. L. Benscoter**, vice president-Orient region, $20,200 salary, 200 shares of common stock, $2,201 expenses; **C. L. Stewart**, vice president-plans, $19,000 salary, 500 shares of common stock, $3,319 expenses; **A. E. Floan**, vice president and secretary, $22,000 salary, five shares of common stock, $1,067 expenses.

D. H. Hardesty, treasurer, (from May 16, 1960), $16,062 salary, 710 shares of common stock, $703 expenses; **M. J. Lapensky**, comptroller, (from June 27, 1960), $7,667 salary, no stock, $71 expenses; **F. J. Scott**, assistant secretary, $12,750, salary, no stock, $339 expenses; **D. Merrick**, assistant vice president-properties, $14,500 salary, 200 shares of common stock, $145 expenses; **R. A. Ebert**, vice president-personnel (from May 16, 1960), $10,000 salary, 20 shares of common and seven shares of 5¼% preferred stock, $394 expenses; **G. M. Bain**, vice president-sales, $34,466 salary, no stock, $825 expenses; **W. J. Eiden**, treasurer, $10,500 salary, no stock, $203 expenses; **A. D. Piepgras**, assistant comptroller, $13,857 salary, no stock, $116 expenses.

C. Hunter, board chairman, no salary, 3,300 shares of common and 1,500 shares of 5¼% preferred stock, $1,932 expenses, $25,000 bonus and indirect compensation; **J. H. Binger**, director, no salary, 2,826 shares of common stock, $918 expenses, no bonus or indirect compensation; **H. Case**, director, no salary, 18,000 shares of common and 23,700 shares of 5¼% preferred stock in the name of others, $1,037 expenses, no bonus or indirect compensation; **M. H. Fry**, director, no salary, 2,700 shares of common stock and 16,000 shares in the name of others, $1,551 expenses, no bonus or indirect compensation; **J. T. Johnson**, director, no salary, 1,000 shares of common stock in the name of others, $1,438 expenses, no bonus or indirect compensation.

M. S. MacKay, director, no salary, 2,000 shares of common stock, $1,011 expenses, no bonus or indirect compensation; **C. B. Morgan**, director, no salary, no stock, $1,275 expenses, no bonus or indirect compensation; **A. Petteys**, director, no salary, 15,000 shares of common and 5,000 shares of 5¼% preferred stock, 6,000 shares of common and 2,000 shares of 5¼% preferred stock in the name of others, $1,356 expenses, no bonus or indirect compensation; **C. F. Reavis**, director, no salary, 3,500 shares of common and 1,167 shares of 5¼% preferred stock, $900 expenses, no bonus or indirect compensation.



Pan Am Installs Collapsible Cargo Containers

Collapsible cargo and mail containers have been installed in the aft sections of Pan American Airways Jet Clippers on transpacific and transatlantic flights. Containers weigh 122 lb. and have a 48 cu. ft. capacity capable of holding 490 lb. of cargo. Each one fills the space of a single seat.

A. G. Redpath, director, no salary, 1,000 shares of common stock, $1,160 expenses, no bonus or indirect compensation; **W. Stern**, director, no salary, 1,000 shares of common and 500 shares of 5¼% preferred stock; $2,753 expenses, $9,600 bonus and indirect compensation; **L. E. Wakefield, Jr.**, director, no salary, 1,000 shares of common stock, $1,000 expenses, no bonus or indirect compensation; **A. J. Weatherhead, Jr.**, director, no salary, 50 shares of common stock, $1,208 expenses, no bonus or indirect compensation; **T. R. Gamble**, director, no salary, no stock, $200 expenses, no bonus or indirect compensation;

Following firms were paid for services rendered during 1960: **Edwin Crittenden**, architectural and engineering services, $8,140; **H. L. Cummins**, public relations, $8,079; **Dorsey, Owen, Barber, Marquart & Windhorst**, legal, $7,263; Ernst & Ernst, accounting, $38,897; **Hodges, Reavis, McGrath & Downey**, legal and financial, $30,163; **Jasper, Winner and Perina**, legal $10,639; **Klagsbrunn, Hanes and Irwin**, legal, $24,167; **Koteen and Burt**, legal, $14,007; **C. Edward Leasure**, legal, $68,035; **Pogue and Neal**, legal, $20,358; **J. Tillisch, M. D.**, medical, $5,071; **Mayo Clinic**, medical, $29,658.

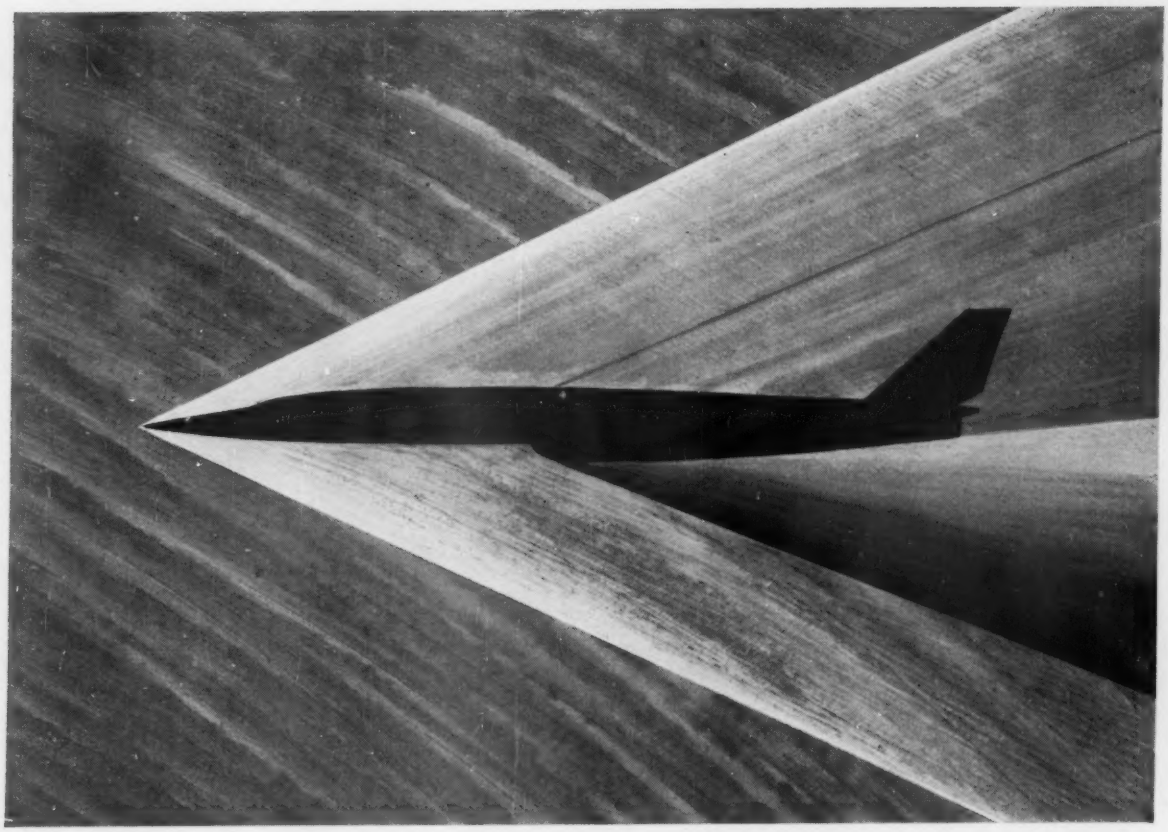
Trans World Airlines—**W. L. Pierson**, board chairman, $64,821 salary, 200 shares of common stock, $11,921 expenses, $4,017 bonus and indirect compensation; **C. S. Thomas**, president and director (resigned July 27, 1960), $42,134 salary, 500 shares of common stock, $7,922 expenses, no bonus or indirect compensation; **E. O. Cocke**, senior vice president and system general manager and director, $45,528 salary, 1,100 shares of common stock, $8,414 expenses, $2,781 bonus and indirect compensation; **A. V. Leslie**, senior vice president-finance and treasurer, $45,528 salary, 90 shares of common stock, $5,014 expenses, $2,488 bonus and indirect compensation; **J. P. Barch**, assistant vice president-industry sales affairs, $18,016 salary, no stock, $6,966 expenses, $1,112 bonus and indirect compensation.

E. W. Barker, assistant secretary, $14,659 salary, no stock, $324 expenses, $908 bonus and indirect compensation; **F. G. Betts**, vice president-purchasing, $23,934 salary, no stock, $1,089 expenses, $1,483 bonus and indirect compensation; **A. J. Brough**, assistant vice president-properties and facilities, $22,516 salary, no stock, $6,206 expenses, $805 bonus and indirect compensation; **E. P. Burke**, assistant vice president and executive assistant to system general manager, $20,141 salary, 30 shares of common stock, $631 expenses, $1,236 bonus and indirect compensation; **F. E. Busch**, vice president-equipment retirement, $30,915 salary, no stock, $3,814 expenses, $1,915 bonus and indirect compensation.

D. J. Crombie, vice president-industrial relations (from Feb. 1, 1960), $24,787 salary, no stock, $5,556 expenses, $984 bonus and indirect compensation; **P. G. Desautels**, vice president-national accounts, $24,931 salary, 254 shares of common stock, $4,732 expenses, $1,545 bonus and indirect compensation; **R. Duckworth**, corporate secretary, $18,165 salary, no stock, $3,889 expenses, $1,112 bonus and indirect compensation; **S. C. Dunlap**, vice president-cargo sales and market development (from Mar. 1, 1960), $21,341 salary, 2,850 shares of common stock, $3,765 expenses, $930 bonus and indirect compensation; **R. M. Dunn**, vice president-technical services, $29,938 salary, no stock, $3,523 expenses, $1,699 bonus and indirect compensation.

H. D. Fellows, assistant vice president-schedule planning and market research, $22,070 salary, 900 shares of common stock, $1,706 expenses, $1,359 bonus and indirect compensation; **C. S. Fullerton**, vice president-sales and services, $26,557 salary, no stock, $6,439 expenses, $1,637 bonus and indirect compensation; **G. L. Gilmore**, vice president-public relations, $25,094 salary, 270 shares of common stock, $4,651 expenses, $1,545 bonus and indirect compensation; **J. I. Greenwald**, assistant vice president-customer service, $20,043 salary, 152 shares of common stock, $3,045 expenses, $1,236 bonus and indirect compensation.

F. D. Hall, vice president and general transportation manager, $32,432 salary, no stock, $9,559 expenses, $1,854 bonus and indirect compensation; **J. D. Harrigan**, regional vice president-sales, $20,075 salary, no stock, $6,155 expenses, $1,236 bonus and indirect compensation; **S. L. Higginbottom**, assistant vice president-engineering, flight test and inspection, $20,206 salary, no stock, $1,323 expenses, $1,236 bonus and indirect compensation; **T. F. Huntington**, vice president (from Apr. 28, 1960), $27,424



Mach 3 Technology

Designing a plane to ride triple-sonic shock waves like a surfboard

For years manned aircraft have been imprisoned in their own V-shaped shock waves which were created when traveling at high speeds. These waves caused a tremendous increase in drag, and a consequent heavy penalty had to be paid in fuel consumption, limiting the range of supersonic flight.

This was the problem facing the engineers at the Los Angeles Division of North American Aviation as they designed the Mach 3 B-70 Valkyrie airplane for the Air Force. The answer lay in an entirely new principle of aerodynamic science which had been discovered by the former National Advisory Committee for Aeronautics. This principle was that, properly designed, a triple-sonic aircraft could actually ride its own air patterns somewhat like a surf-rider on the crest of a wave.

North American engineers set out to design a wing and undersurface which would make use of this aerodynamic principle. The result was a delta wing shaped in the V which would be made by air waves when flying at Mach 3 speeds. The design was highly practical. With this new design advance, there now exists a means for manned aircraft to not only reach triple-sonic dash speeds, but to cruise for intercontinental distances at them.

Advanced design achievements like this will help sustain America's leadership in aircraft by making possible the Mach 3 B-70 and future commercial aircraft.

Builders of the B-70 Valkyrie

THE LOS ANGELES DIVISION OF **NORTH AMERICAN AVIATION, INC.**

salary, 100 shares of common stock, $1,524 expenses, $1,341 bonus and indirect compensation.

A. E. Jordan, assistant vice president-maintenance and overhaul, $22,135 salary, no stock, $705 expenses, $1,359 bonus and indirect compensation; **J. W. Letzkus**, regional vice president-sales, $24,032 salary, 400 shares of common stock, $8,779 expenses, $1,483 bonus and indirect compensation; **J. T. Logan**, assistant vice president-scheduling, $18,192 salary, 32 shares of common stock, $525 expenses, $1,112 bonus and indirect compensation.

L. P. Marechal, vice president and general sales manager, $27,783 salary, no stock, $9,854 expenses, $1,699 bonus and indirect compensation; **J. N. Martin**, regional vice president-sales, $24,032 salary, no stock, $6,686 expenses, $1,483 bonus and indirect compensation; **R. Mazzarrini**, vice president-international sales development, $19,945 salary, 100 shares of common stock, $8,153 expenses, $1,236 bonus and indirect compensation; **C. E. McCollum**, vice president (retired Jan. 31, 1960), $1,852 salary, 198 shares of common stock, no expenses, no bonus or indirect compensation.

J. P. Mead, assistant vice president-industrial relations, $22,102 salary, no stock, $2,734 expenses, $1,359 bonus and indirect compensation; **R. E. Montgomery**, regional vice president-sales, $27,230 salary, no stock, $9,313 expenses, $1,483 bonus and indirect compensation; **R. B. Mueller**, assistant vice president-flight operations, $27,490 salary, no stock, $2,292 expenses, $1,699 bonus and indirect compensation; **W. E. Rooker**, assistant treasurer, $20,108 salary, no stock, $509 expenses, $1,236 bonus and indirect compensation; **R. K. Rourke**, assistant vice president-equipment planning and development, $21,072 salary, no stock, $5,300 expenses, $1,297 bonus and indirect compensation; **R. W. Rummel**, vice president-planning and research, $27,124 salary, no stock, $7,073 expenses, $1,699 bonus and indirect compensation.

R. A. Schlieder, assistant vice president-financial planning and analysis (from June 1, 1960), $13,056 salary, no stock, $1,215 expenses, $823 bonus and indirect compensation; **T. K. Taylor**, vice president-Washington affairs, $27,587 salary, no stock, $7,480 expenses, $1,699 bonus and indirect compensation; **J. W. Thomas**, vice president-civic affairs, $20,075 salary, no stock, $5,430 expenses, $1,236 bonus and indirect compensation; **W. L. Trimble**, regional vice president-transportation, $33,972 salary, no stock, $3,907 expenses, $1,637 bonus and indirect compensation.

F. W. Ayers, director, $1,800 salary, no stock, $3,504 expenses, no bonus or indirect compensation; **P. Bradley**, director, $2,000 salary, no stock, $3,361 expenses, no bonus or indirect compensation; **R. A. Cook**, director, $3,600 salary, no stock, expenses, bonus or indirect compensation; **O. Holcombe**, director, $2,800 salary, no stock, $5,459 expenses, no bonus or indirect compensation; **R. M. Holliday**, director, $3,800 salary, no stock, expenses, bonus or indirect compensation; **S. Maestre**, director, $2,400 salary, 332 shares of common stock, $1,532 expenses, no bonus or indirect compensation; **M. E. Montrose**, director, $2,200 salary, no stock, $3,406 expenses, no bonus or indirect compensation; **C. H. Price**, director, $3,100 salary, no stock, $4,199 expenses, no bonus or indirect compensation; **H. E. Rogers**, director, $2,600 salary, no stock, $4,161 expenses, no bonus or indirect compensation; **B. Sessel**, director,, $3,300 salary, no stock, $28 expenses, no bonus or indirect compensation, **A. D. Simpson**, director (deceased Dec. 25, 1960), $600 salary, 334 shares of common stock, $990 expenses, no bonus or indirect compensation; **T. A. Slack**, director, $2,200 salary, no stock, $1,392 expenses, no bonus or indirect compensation; **M. H. West, Jr.**, director, $1,200 salary, no stock, expenses, bonus or indirect compensation; **L. Wright**, director, $1,600 salary, no stock, $2,594 expenses, no bonus or indirect compensation.

Following firms were paid for services rendered during 1960: **Abbey Limousine**, limousine service, $7,410; **Airline Delivery Service Co.**, messengers, $8,920; **Louis R. Barbier**, setting up advertising displays, $8,994; **Beckel's Luggage Shop, Inc.**, luggage repairs, $10,236; **Block & Co.**, commission, $28,277; **Carey Transportation, Inc.**, limousine service, $58,780; **Chadbourne, Parke, Whiteside & Wolff**, legal $628,055; **Chemical Bank New York Trust Co.**, transfer agent for company stock, $7,409; **Cresap, McCormick & Paget**, management consultants, $140,120; **Dillon Reed and Co., Inc.**, financing services, $187,500 (partial payment); **Ebasco Services, Inc.**, actuarial services, $7,822; **Employers Overload Co.**, clerical services, $29,181; **Equitable Life Assurance Co.**, fees in connection with financing, $185,000.

Foote, Cone & Belding, advertising, $82,408; **Frietsch Services**, clerical services, $7,890; **The Greater New York Fund, Inc.**, contribution, $6,505; **Haskins & Sells**, audit and professional services, $121,100; **Heart of America United Campaign Fund**, annual contribution, $15,000; **William F. Hogan Associates, Inc.**, retainer fee, $26,767; **Institute of Visual Training**, charges for booking, inspecting and shipping film, $10,432; **The Interstate Co.**, services at San Francisco Ambassador Club, $10,685; **Granville B. Jacobs**, consultant, $17,703; **Kansas City Area Council, Boy Scouts of America**, contribution, $10,000; **George A. Koteen Associates** utility rate consultants, $5,432.

Lazard Freres & Company, financing services, $93,750 (partial payment); **Lehman Bros.**, financing services, $93,750 (partial payment); **Samuel H. Liberman**, legal, $21,746; **Raymond Loewy Corp.**, industrial designer consultant, $163,238; **Mike Lyman's Inc.**, services at Los Angeles Ambassadors Club, $16,971; **Manpower, Inc.**, clerical services, $28,568; **National Travelers Aid Assn.**, contribution, $6,491; **Poletti & Freidin**, legal, $93,184; **Spencer, Fane, Britt & Brown**, legal, $9,337; **Stinson, Mag, Thomson, McEvus & Fizzell**, legal, $19,535; **Universal Agency, Inc.**, advertising, $30,555; **Wright, Wright, Goldwater & Mack**, legal, $13,283.

Norden Lays Framework to Become Major Avionic Prime Contractor

Norwalk—Contract for deliveries of an all-weather advance search radar and terrain clearance system for the Navy Grumman A2F-1 attack aircraft marks the second phase in Norden's transition from an independent company to a division of United Aircraft Corp.

The $2.6-million contract from Grumman, prime contractor for the A2F-1 Intruder (AW Oct. 24, p. 66) calls for continued production of an integrated radar and television system, with two scopes providing a visual representation of conditions ahead and below the low-level, high-speed aircraft, even in zero visibility. It is indicative of the future Norden is planning for itself, now that the initial phase of United's acquisition, reorganizing, reshaping, and funding is completed.

Navigation and bomb-director systems have been a specialty of Norden throughout its 30-year-plus history. The bombsight developed for the B-17 and B-29 during World War II was perhaps its best-known product. In 1955, Norden merged with the Ketay Instrument Corp. and the organization began to branch out into many diverse, and sometimes unrelated, areas.

At the time of United's acquisition in 1958, Robert A. Aspinwall, Norden's present general manager, described the company's position as "precarious." "There was a critical shortage of working capital," he said, "and costs far exceeded sales. The corporation faced a stretchout of existing programs and cancellation of others. Its new business volume was sharply reduced, necessitating a reduction in total personnel of more than 20%." Further, all plants and facilities were leased and adequate floor space was lacking. Equipment and tools were unsatisfactory, he said, and the geographic dispersion of all the elements of Norden-Ketay made internal communications "almost impossible."

United's first move was to prune and consolidate the scattered organization of Norden-Ketay, which had operated subsidiaries, plants and laboratories in 21 different locations within four states.

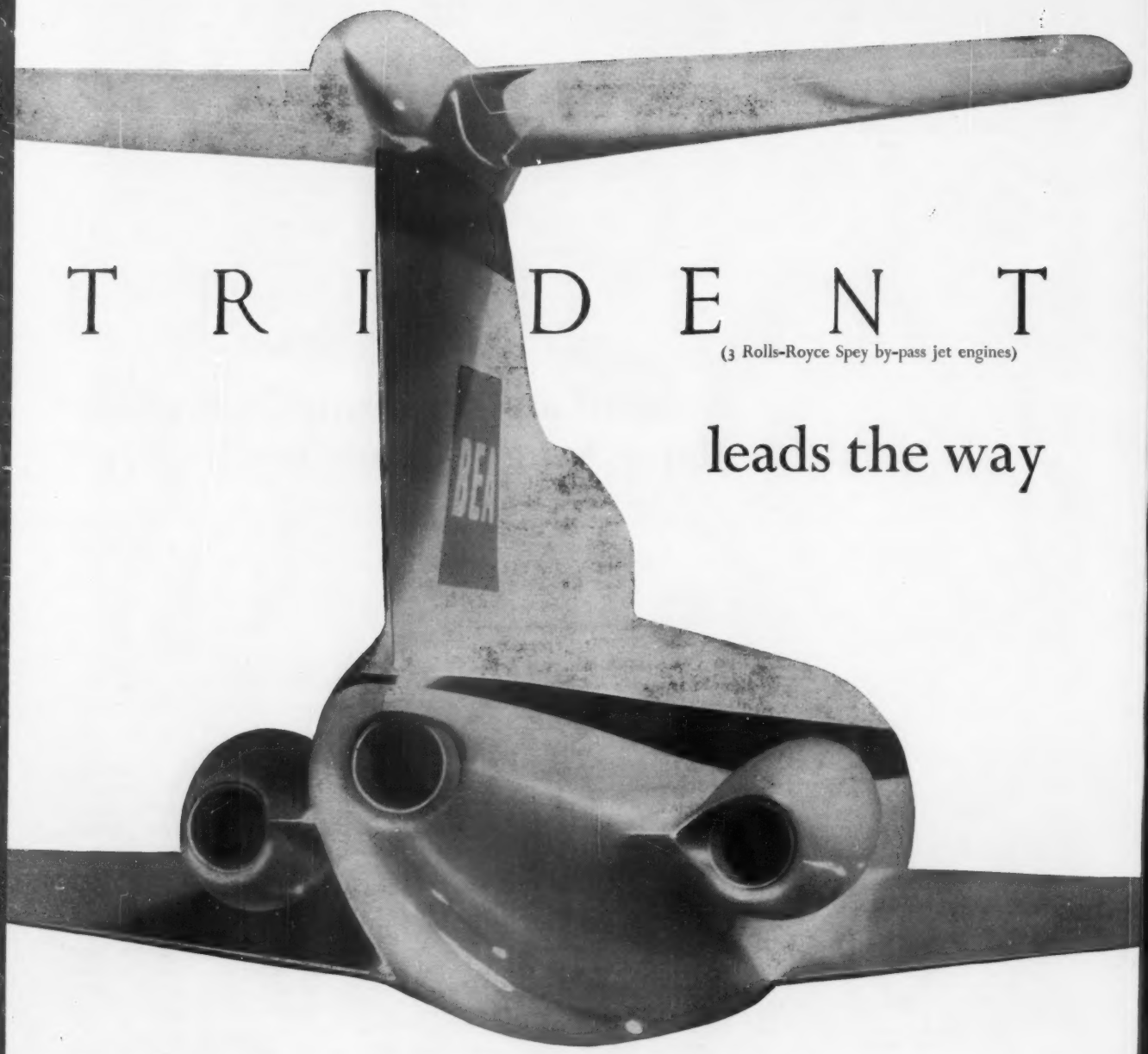
Nuclear Science and Engineering Co., Pittsburgh, Pa., a firm specializing in nuclear contamination analyses of air, liquids and personnel was spun off and sold to its original owners. A gear works plant in Florida, operating on a job shop basis, was liquidated and its facilities and equipment sold. A rotating parts plant in California was dropped and its function picked up by the Ketay department on Long Island. Other West Coast operations were consolidated. Expired leases on facilities were not renewed; others were sublet.

The accounting and purchasing departments, which had been split into four separate operating groups in New York and Connecticut, were brought together in two offices. Finally, after investigating several possible sites in New York and Connecticut a new 350,000 sq. ft. plant was built outside Norwalk, fronting on the Connecticut Turnpike, and now houses Norden's administrative offices, research laboratories and manufacturing lines.

Where Norden-Ketay had operated in 21 different locations, Norden-United Aircraft now has three facilities: Norwalk, Conn., front office and military systems; Ketay department, at Commack, Long Island, N. Y., where rotating components and other special electronic parts are manufactured; and Costa Mesa, Calif., where commercial and industrial control systems and other products are produced.

Only the Commack plant is leased; the other two facilities are owned by United Aircraft.

"In pulling together 11 different



TRIDENT

(3 Rolls-Royce Spey by-pass jet engines)

leads the way

The sophisticated design of this second-generation short-haul jet is the outcome of de Havilland's vast experience in the development of the medium-size jet airliner

Hawker Siddeley Aviation Limited is the force behind this world-market project

HAWKER SIDDELEY AVIATION, 32 DUKE STREET, LONDON, W. 1.

plants in the New York-Connecticut area into our Norwalk and Commack sites," Aspinwall said, "we expected a certain amount of attrition among our technical personnel. Surprisingly, this didn't happen. We did lose some secretarial help, but we kept all the key people we wanted." Norden now employs about 2,200 people, approximately two-thirds of that number being located at Norwalk, and this compares with Norden-Ketay's 2,000 personnel strength in 1958.

Acquired to fill a gap in United's technological spectrum and to provide United Aircraft Corp. with an entry into the growing electronics sales market, Norden today is primarily interested in navigation, bomb-director, stabilization and guidance systems, secondarily in radar-television systems (other than navigation), optics, gas pressure systems, special components and, in the non-military Costa Mesa plant, automatic control systems and vote-tallying and educational scoring machines.

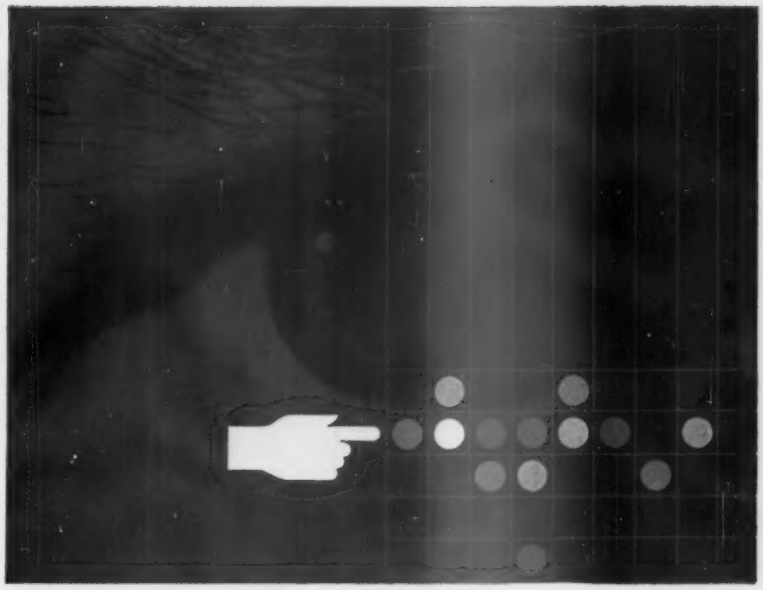
"In our major field of interest," Aspinwall said, "we intend to bid as the electronics prime contractor on every new project that comes along—whether it's an aircraft, missile, space or maritime system." In secondary areas, Norden would like to provide assemblies and subassemblies as first-tier subcontractor.

No longer one-service oriented, Norden is presently working on various projects for the Air Force, Navy, National Aeronautics and Space Administration, Federal Aviation Agency and other governmental organizations.

Norden is currently an associate prime contractor on two aircraft (Grumman A2F-1 and Douglas A3D) for navigation and bomb-director systems. As a subcontractor, the company has developed for the Navy a contact analog which displays a submarine's position relative to bottom and surface, pitch, roll, heading and speed, all on a single screen before the helmsman. For the Air Force, Norden has built a television overlap computer system, which automatically actuates an aerial reconnaissance camera to produce overlapping consecutive photographs and a television theodolite for missile tracking.

Last year, the company received a nine-month study contract from the Maritime Commission to determine the feasibility and economics of a fully-automated merchant ship. The study covered the requirements and possible designs of command-and-decision computers, navigation and collision-avoidance systems and, as performed by two other United Aircraft Divisions, Pratt & Whitney and Hamilton Standard, propulsion and controls systems.

Under corporate sponsorship, Norden has produced a small, 20-lb. all-attitude inertial platform and it is



THINK, ACT! How will crews of aerospace vehicles perform under long periods of stress and confinement? Lockheed/Georgia finds accurate answers in the crew mockup section of its Behavioral Research Lab – just one of the many capabilities of its highly qualified Human Factors Research Group. **LOCKHEED/GEORGIA**

Marietta, Georgia

PROBLEMATICAL RECREATIONS 66

Ann, Barbara, Carol, and Dorothy are members of the Bobby-Sox Club. Every pair of members is together on one and only one committee. Each committee has exactly 3 members. What is the smallest possible total membership, and how many committees are there? — *Contributed*

Now being used by range manufacturers is our new Microtron Unit for rf cooking. Heart of the unit is the newly developed L-3189, one-kilowatt CW magnetron that reaches full operating power in less than 6 seconds! Cooking time is equally speedy: steak, medium, 3.5 min. Address questions regarding Litton tube advances to: Electron Tube Division, San Carlos, California.

ANSWER TO LAST WEEK'S PROBLEM: On the average, the entire set of 52 cards will be obtained in 52 $(1/52 + 1/51 + \ldots + 1/3 + 1/2 + 1)$ trials. Hence the average number of trials will be $52 \sum_{n=1}^{52} 1/n$, or 235.976, and since we must buy an integral number of cigarette packets the number will be 236.

LITTON INDUSTRIES, INC.
Beverly Hills, California

understood that the company has recently proposed the unit to a military agency—presumably the Air Force—for satellite application.

Other current company projects include a pressure sensing system for jet engines, inertia stabilizing wheels for Midas and Samos satellites (AW Jan. 23, p. 23) and an angular measurement device, called Microgon, which is reported to be accurate to 3 sec. of arc.

Norden does not plan to compete with electronic component manufacturers. "We will continue to make those components which are necessary for systems we are building," said Aspinwall, "as well as those for which we have an established market, like our analog-digital converter. But aside from that, we're staying out of the component business."

Again only to the extent of satisfying its own needs, Norden is delving into microminiaturization and molecular circuitry. "If this sort of work is farmed out to component manufacturers," Aspinwall said, "they will, in effect, wind up supplying us with completed circuits. From there, it would be but the next step to assemble the system itself. So, we'll do it ourselves."

The Costa Mesa department of Norden last year delivered an electronic vote-tallying system to Los Angeles County. The machine, which can sort and tabulate 600 votes per minute, was approved in January this year, after extensive testing, and will be used more and more in California, according to the state's Commission on Voting Machines and Vote Tabulating Devices.

New Offerings

Kawecki Chemical Co., Boyertown, Pa.; business is in the inorganic field of chemistry, and more specifically in the field of the less familiar metals and their compounds, including tantalum, columbium, selenium, titanium, zirconium and boron, some of which are combined in master alloys produced by the company. It also has done research work on gallium, scandium, tellurium and other semiconductor compounds and has set up pilot plant operations to produce some of these materials. Offering is $3,500,000 of 4⅞% convertible subordinated debentures due 1976, and 17,282 shares of common stock issuable upon exercise of warrants. Debentures are to be offered for subscription by stockholders at 100% of principal amount, and at the rate of $100 principal amount of debentures for each 15 shares held; record date and underwriting terms to be supplied by amendment. Proceeds will be used for the retirement of bank indebtedness; for expansion of existing facilities used for production of tantalum, columbium, master alloys and other products currently being produced; balance will be added to the general funds of the company to be available for general working capital.

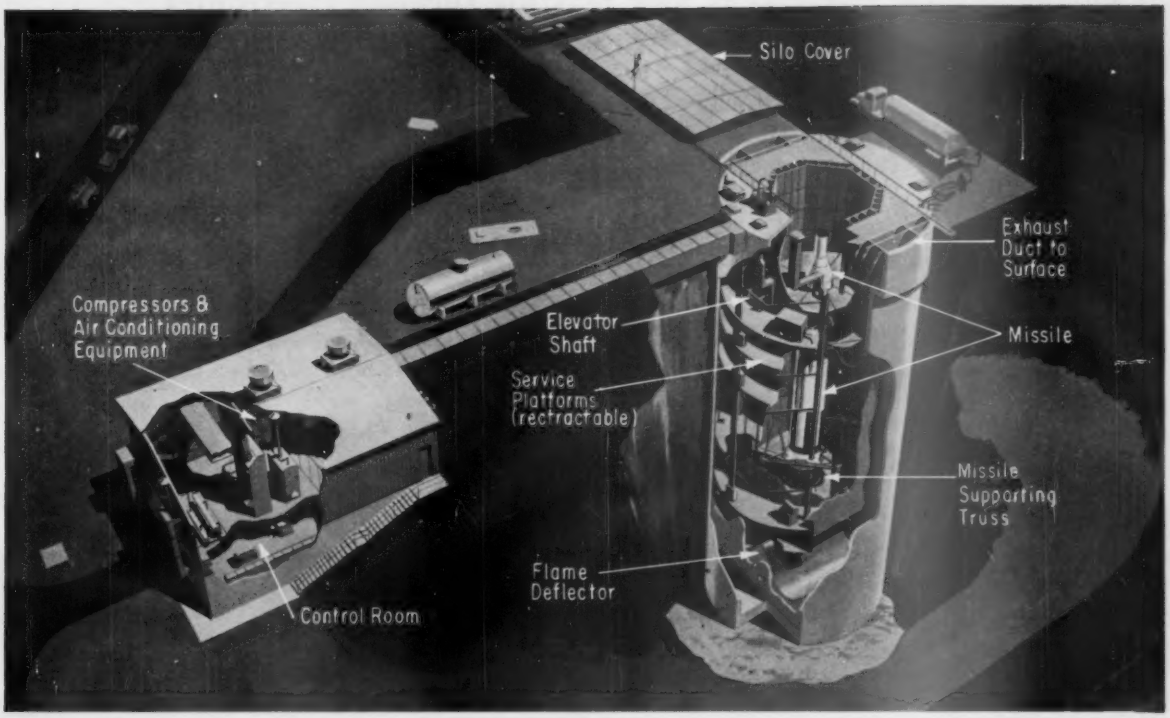
Potter Instrument Company, Inc., Plainview, N. Y., engaged in the design, manufacture and sale of electronic data processing equipment, including high speed digital magnetic tape transports and systems and other products used in electronic computers, industrial controls and data reduction equipment and military information systems. Offering is 210,000 shares of common stock, for public sale at $10 per share on an all or none basis; 190,000 shares for sale by the company and 20,000 outstanding shares by John T. Potter, president and board chairman. Proceeds of the company's stock will be used to retire bank loans incurred to finance accounts receivable and inventories, and to carry increased amounts of these items; to accelerate the company's product development and tooling; balance will be added to working capital and used principally for additional research and development.

Sealectro Corp., Mamaroneck, N. Y., engaged primarily in the development, manufacture and sale of electronic components and subassemblies for use in electronic and electrical equipment, aircraft, missile, communications, and data-processing industries. Offering is 231,600 shares of common stock; 100,000 shares for public sale by the company, 110,000 outstanding shares by William Silberstein, company president, and 21,600 outstanding shares by another stockholder. Offering price and underwriting terms to be supplied by amendment. Proceeds of the company's sale will be used to repay a bank loan incurred in 1959 in the acquisition of a former stockholder's interest, and to pay the balance due to such stockholder by virtue of such acquisition; balance will be used to expand plant facilities, purchase additional machinery.

Wayne-George Corp., Boston, Mass., engaged in the design, development and manufacture of digital transducers, also known as analog-to-digital encoders, and in research and development of new types of digital encoders to improve and expand its line of products. Offering is 80,000 shares of common stock; 60,000 shares for public sale by the company and 20,000 outstanding shares by George H. Wayne, president and principal stockholder. Offering to be made on an all or none basis; offering price and underwriting terms to be supplied by amendment. Proceeds of the company's sale will be used for payment of a note ($50,000); for machine tools, laboratory test and measuring instruments and new plant facilities; for company-sponsored research and development and expansion of its staff of engineers and technicians; the balance for working capital, of which up to $100,000 may be used to increase inventories.

Microwave Associates, Inc., Burlington, Mass.; bulk of the company's design and production effort has been devoted to supplying manufacturers of radar and telecommunications systems with specialized components and accessories associated with the generation, reception, switching and measurement of microwave radio energy. Offering is 240,000 outstanding shares of common stock for public sale by the holders thereof; initial public offering price will be related to the current market price of the stock on the American Stock Exchange at the time of the offering. Underwriting terms to be supplied by amendment.

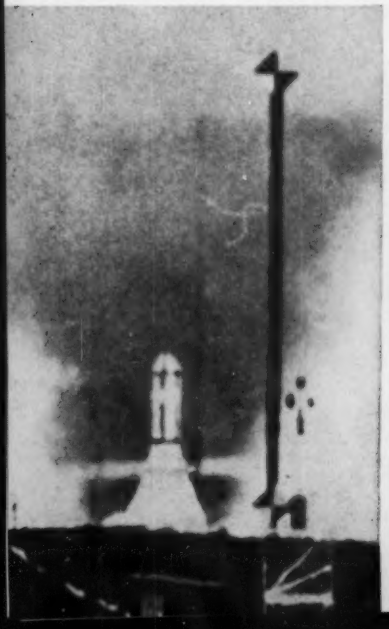
Trans World Airlines, Inc., New York, N. Y., engaged in transcontinental and international air transportation. Offering is $111,235,900 of 6½% subordinated income debentures, due 1978, and warrants for the purchase of common stock. TWA proposes to offer holders of its common stock the right to subscribe to said debentures, with common stock purchase warrants, at the rate of $100 principal amount of debentures for each six shares held. Terms of the warrants, record date for subscriptions, and subscription price to be supplied by amendment. Under an agreement between TWA and Hughes Tool Co., the beneficial owner of voting trust certificates issued with respect to 5,221,301 shares (78.23%) of the company's outstanding common stock, Hughes Tool Co. may buy, at the subscription price, all or any part of the debentures not purchased under the subscription offer, and has agreed to purchase such number of debentures as will, with debentures purchased by it and others under said offer, provide the company with at least $100,000,000. TWA paid in part for the cost of jet aircraft by the issuance to Hughes Tool Co. of a 6½% interim subordinated note in the amount of $100,000,000. As part of that transaction and in connection with its issuance of equipment mortgage notes, the company agreed to make this debenture offering to stockholders and to use the proceeds thereof, to the extent required, to pay such interim subordinated note at 100% of principal amount thereof (to the extent such note is not applied directly by Hughes Tool Co. to purchase debentures). Accordingly, proceeds from the debenture sale will be applied to the payment of said note; any balance from the sale will be used by TWA for general corporate needs.

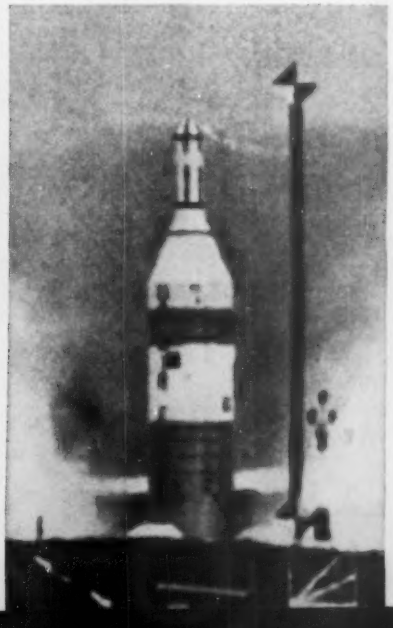


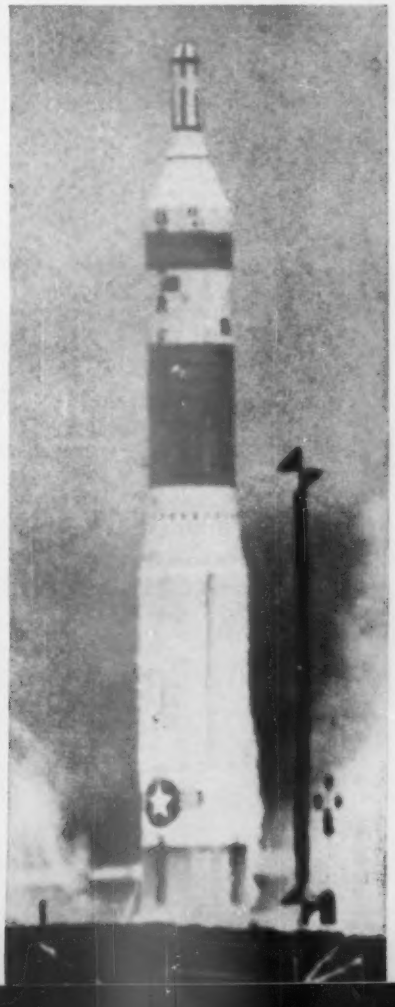
Artist's sketch shows cross-section of silo launch test facility from which first Martin Titan underground firing was made (AW May 8, p. 30). Designed and built by Ralph M. Parsons Co., silo is lined with 3-ft. thick acoustical modules.

Titan I Underground Silo Launch Firing Meets All Air Force Test Objectives

Martin Titan is shown lifting-off from Vandenberg Air Force Base underground silo in sequential photos. Purpose of the Titan I firing was to determine the capability of the 146-ft. deep concrete tube to launch the missile as well as to subject the missile to the stresses required in the firing. Preliminary studies made by the Air Force's Ballistics Systems Division, Space Technology Laboratories, and Aerojet-General's Advanced Research Division, which made 1/6th scale model test firings, contributed to the successful in-silo launch. Air Force described the flight as meeting all test objectives.







Total human system analysis is now feasible through electronics

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Ampex, an established leader in magnetic tape instrumentation, provides a basic key to the problems of measuring, comparing and analyzing medical data. Ampex and its equipment currently play an active role in over 150 medical research programs, including neurophysiological, psychophysiological, biochemical, electrocardiographic and cardiovascular analysis. Specific emphasis has been placed on compatibility with the latest data reduction and computing devices.

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BEAGLE-AUSTER TERRIER is civil version of the Auster Mk. 6 used by British army. Long exhaust pipe running under cabin has been added for sound supression. Interior features include automobile type upholstery and also extensive cabin soundproofing.

Airedale, Terrier Unveiled at British Show

By Herbert J. Coleman

Coventry, Eng.—Beagle A109 Airedale and Beagle-Auster Terrier bowed into international business plane competition at the W. S. Shackleton air show here.

Beagle—British Executive and General Aviation, Ltd.—plans to sell the swept tail, tricycle landing gear Airedale for $12,000. Scheduled to come off the production lines at Rearsby this month, the Airedale eventually will hit a 10-per month production rate (AW May 8, p. 28).

Beagle is also planning to expand into the twin-engine field and expects to unveil a completely new aircraft at the Farnborough show in September.

A61 Terrier

The other airplane, designated Beagle-Auster A61 Terrier, also shown for the first time, is a two-to-three seat trainer and sport aircraft developed from the Auster Mark 6 series now in service with the British army. It sells for $4,500 in the standard configuration.

The Airedale is a refinement of the Auster series of high wing aircraft with front and rear doors and a separate baggage door, wheel-type controls replacing the former stick, and tricycle gear with a steerable nose wheel. Starting sequence switches have been relocated to the roof. It will compete in the U. K. directly with the Cessna 175 and, when production commitments allow, the new Piper Cherokee four-placer now being built at Vero Beach, Fla.

Airedale powerplant is a 180-hp. Lycoming O-360 engine driving a McCauley constant-speed metal propeller: cruise speed is said to be better than 140 mph. and still-air range is 1,050 stat. mi., with 7.6 hr. endurance.

Engine includes an ejector exhaust system to obtain a small amount of thrust: exhaust outlet is a nozzle to reduce back-pressure at altitude. System was first designed for Rolls-Royce Merlin engines in World War II.

Wingspan is 36 ft., length is 25 ft. 10 in., and height is 9 ft. 2 in. Wing area is 184.5 ft. and gross weight is 2,750 lb. Provision has been made for a fuel capacity of 52 gal. to gain the maximum range: normal fuel load is 32 gal. for a 650-mi. range. At economic cruise setting, this works out to a consumption of 6½ gph.

Stall Speed

Beagle says the Airedale will take off, clearing a 50-ft. obstacle, in 595 yd. and has a service ceiling of 14,900 ft. Initial rate of climb is 730 fpm. Flapdown stall speed is 52 mph.

Plane has been fitted with slotted flaps for improved short field takeoff and landing characteristics. Construction features extensive use of plastics for

TERRIER cockpit as displayed at Shackleton air show is shown in closeup.

91 OUT OF 96

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CESSNA LINEUP at Shackleton air show's Aviation Weekend includes, from left, the 172, 310F, 175 and 150. Cessna influence on Airedale is evidenced by swept tail. Beagle says the Airedale was designed with FAA requirements in mind.

wheel fairings, window moldings, wing tips, tail fairings and dorsal fin. Rotating Beacon will be standard equipment.

Although the Airedale was developed from the basic Auster design, Beagle says only 130 days elapsed from the drawing board to first flight. Original Auster jigs have been modified for the production line.

U. S. influence on the Airedale was most evident in the swept tail, a design spearheaded in the lightplane field by Cessna Aircraft. Peter Masefield, managing director of Beagle, said the plane was designed with Federal Aviation Agency requirements in mind, and that eventually it may be offered for sale in the U. S. but that any such plans are premature at the moment.

To spur sale of Beagle aircraft, Masefield currently is setting up Beagle Finance, Ltd., a wholly owned subsidiary which will arrange lease terms over long-range-periods of up to five years, and installment purchases on long-term contracts. Details are still being worked out.

The A61 Terrier, the other Beagle entry, is powered by a 145-bhp. de Havilland Gypsy Major 10 engine. Cruise speed is 110 mph. and the plane primarily is aimed at flying schools and club activities. Interior features automobile type upholstery and trim and extensive soundproofing of the cabin. In addition, Beagle has extended the engine exhaust and added a muffler for further suppression of sound.

Terrier gross weight is 2,350 lb. and has a 22-gal. fuel supply. Maximum speed is 123 mph. and range is 415 mi. The plane can clear a 50-ft. obstacle in 235 yd. and has an initial climb rate of 810 fpm.

Dimensions are: span, 36 ft., length 23 ft. 3 in., height 8 ft. 11 in., and wing area 184 sq. ft. Engine turns a Fairey-Reed metal fixed pitch propeller.

The two British light aircraft were displayed in an international roster including entries from Germany, Czechoslovakia, Italy, France and the United States at Shackleton's Aviation Weekend—devoted to light and business planes.

The event drew more than 4,000 persons to observe—and possibly buy—40-odd makes of planes ranging from the Grumman Gulfstream to the French Jodel Musketeer. Most British dealers were represented and first official sale was made by Short Brothers & Harland, Beech dealers who sold a Queen Air to British Oxygen Co., Ltd.

Successful Show

Shackleton said the fourth annual show was the most successful yet and demonstrated a growing interest in revival of both private and club flying, along with heavier business planes in the multi-engine class. Shackleton has purchased the first six Beagle Auster Airedales off the production line, for sale in U. K.

Indication of British lightplane activity, he noted, was the fact that there were 3,000 aircraft movements during the three-day show, despite marginal weather. On the closing day, there were 700 landings and takeoffs. At a peak of 90-min. period, there were 142 takeoffs, with roughly half those airplanes returning for landings.

In the larger classes, a Gulfstream owned by Greek shipping magnate Stavros Niarchos was on display for one day, and the Avro 748 twin turboprop No. 1 prototype made a short flight demonstration. Plans for a showing of a Fokker F.27 used by Holland's Prince Bernhardt were canceled at the last minute due to assignment of the plane elsewhere.

In the lighter classes, the show was captured by the Airedale which made its initial flight only two weeks previous, after Ranald Porteus, test pilot, made a short taxi run. It had flown only 4 hr. prior to the Aviation Weekend, because Beagle was forced to ground the aircraft for painting and final trim.

British breakthrough in the light aircraft field was discussed at the meet. Room for major expansion was cited by Tim Vigors, of Vigors Aviation, Ltd., Kidlington, British Piper dealer and one of the prime movers in formation of a new association designed to promote business flying.

The group, now in its final stages of formation, is the Business Aircraft Users Assn., headed by M. A. H. Bellhouse, chairman of Beagle and deputy chairman of Pressed Steel Co., Cowley, car maker which formed Beagle as a subsidiary. Activation of the association was an outgrowth of studies by the Business Aviation Advisory Committee of the Royal Aero Club, which was headed by Vigors.

The new association will scrutinize all phases of business aviation and among initial projects will be the activation of a Central London Airport aimed particularly at this phase. First move probably will be toward reopening of London-Croydon, closed 18 months ago and now used for auto storage, although runways and hangars are still available.

At present, business aircraft can fly within a 1 hr. drive of downtown

Airedale Price

Beagle-Auster Airedales are priced at $12,000. The conventional-gear three-seat Terrier will be marketed for about $4,500. Aviation Week's original price quotations for the aircraft of $3,800 and $1,596 (AW May 8, p. 28) respectively were incorrect.

May 5, 1961–First released photograph taken from NASA Freedom 7 Mercury capsule duplicates Cmdr. Shepard's view of eastern coastline of the United States. Astronaut's view through Perkin-Elmer periscope covered 1600 miles.

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An eye for an astronaut—designed and built by Perkin-Elmer . . . a highly precise optical system that provides a 175° clear view of the earth below, with the option to superimpose a magnified 19° view in the center of the periscope display screen . . . lightweight, yet rugged to withstand a journey into space and return.

More than just a viewer, the periscope supplies vital navigational data: drift, pitch, roll, true vertical, retrograde angle. The periscope also serves as an "optical altimeter" since barometric altimeters cannot function in space.

Following Mercury from the ground was another P-E system—the 500 inch focal length ROTI. This automated tracker is used to photographically record the behavior of missiles in flight.

The unique periscope for the NASA Mercury capsule is an example of Perkin-Elmer capabilities in precision optics and electronics—and the experience it can employ to meet the challenge of space age instrumentation. Other examples: guidance alignment equipment for missiles like Titan, Atlas, Pershing . . . infrared systems . . . spectrometers for planetary and high altitude probes . . . complex telescopes for flights such as Project Stratoscope II.

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Scientists and engineers interested in challenging careers are invited to write the Director of Industrial Relations. All qualified applicants will be considered regardless of race, creed, color or national origin.

Beagle-Auster A.109 Airedale

Specifications

Span	36 ft. 0 in.
Length	25 ft. 10 in.
Height	9 ft. 2 in.
Wheelbase	5 ft. 10 in.
Track	6 ft. 0 in.
Wing area	184.5 sq. ft.
Flap area	11 sq. ft.
Gross weight	2,750 lb.
Max. wing loading	14.9 lb./sq. ft.
Max. power loading	15.3 lb./bhp.
Fuel capacity, standard	32 gal.
Fuel capacity, long range	52 gal.
Basic equipped weight, less fuel and oil	1,630 lb.
Disposable load	1,120 lb.
Baggage compartment	5 cu. ft.

Performance

Max. level speed (sea level)	148 m.p.h. TAS
Max. continuous cruise 5,000 ft.	141 m.p.h. TAS
Max. economy cruise 7,500 ft.	135 m.p.h. TAS
Stalling speed, flaps up	60 m.p.h. EAS
Stalling speed, flaps down	52 m.p.h. EAS
Initial rate of climb	730 fpm.
Time to 5,000 ft.	8.5 min.
Time to 7,500 ft.	15.0 min.
Service ceiling	14,900 ft.
Takeoff distance to unstick, still air, runway	325 yd.
Takeoff distance to unstick, still air, grass	400 yd.
Takeoff distance to clear 50 ft., still air, runway	595 yd.
Takeoff distance to clear 50 ft., still air, grass	665 yd.
Landing distance from 50 ft. to rest, still air, runway	425 yd.
Landing distance from 50 ft. to rest, still air, grass	445 yd.
Ground roll, still air, runway	180 yd.
Ground roll, still air, grass	200 yd.
Max. range with normal payload (4.8 hr.)	650 mi.
Max. range with 700 lb. payload plus 52 gal. fuel and at economy cruise (at 135 m.p.h. TAS) at 7,500 ft. no reserves	1,050 mi.

(Powerplant: Lycoming O-360-A1A, 180 bhp.)

London, from Croydon, the drive is about 35 min. London Airport (Heathrow) has somewhat relaxed its restrictions and will allow multi-engine business planes to land, provided the plane has proper radio equipment and the pilot is qualified and licensed for instrument flying. There is some agitation for London Airport to provide VFR holding patterns for lighter aircraft, but this is far in the future.

Association chief executive is Sqdn. Ldr. R. R. Stephenson, who said some of the aims will be:

• **Opening or "keeping open"** suitable airports and landing strips for business planes.

• **Represent members to relevant** authorities on questions regarding airspace regulations or restrictions.

• **Increase and improve** customs facilities at airports throughout the United Kingdom and "to insist that the present time-wasting procedures are removed" where any justifiable case exists.

Association, he added, also will watch pertinent legislation involving business flying and provide flight briefing services for members for trips in the U. K.

At Shackleton, U. S. aircraft dominated the static displays at the show, with considerable interest generated by the Piper Colt sportplane (Vigors Aviation has sold 30 so far) but the flying display was more or less taken over by the twin-engine Dornier Do. 28 and the Helio Super Courier. Both planes concentrated on STOL characteristics, keeping all maneuvers within the Baginton Airport runway length at altitudes from 10 to 300 ft.

Only jet entered was the Miles Student, which made a short flyby. Aside from the Beech-Cessna-Piper line, others in the flight demonstration were the Bolkow F. 207 and Bolkow-Klemm KL. 107C; Dornier's Do. 27 and 28; Jodel's Ambassador and Musketeer; a Lancashire Prospector; Czech Omnipol Aero 145, Metal-Sokol and Morava; and the Italian Piaggio P 166 twin.

Smallest plane at the show was a Druine D36 Turbulent low-wing single seater powered by a JAP J. 99 engine.

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MAY 5, 1961—AMERICA'S FIRST MAN IN SPACE. *North American Aviation joins all of America in saluting Cmdr. Alan B. Shepard, Jr., USN—the Free World's first astronaut. The historic flight was a major step in America's man-in-space Mercury program, directed by the National Aeronautics and Space Administration. The power that put an American in space was provided by a Redstone liquid propellant rocket engine. The next step will be an orbital flight powered by an Atlas engine. Both the Redstone and Atlas engines are produced by the Rocketdyne Division of North American Aviation. Rocketdyne is now testing immensely more powerful engines. The Saturn booster will be able to orbit 40 tons. The giant F-1 engine, which has already achieved a thrust of 1,640,000 pounds, may well give America space supremacy. Rocketdyne is the Free World's leading producer of large liquid propellant rocket engines—engines that have already powered 36 out of 40 of America's successful satellites and space probes and that have proved their reliability for manned space flight.*

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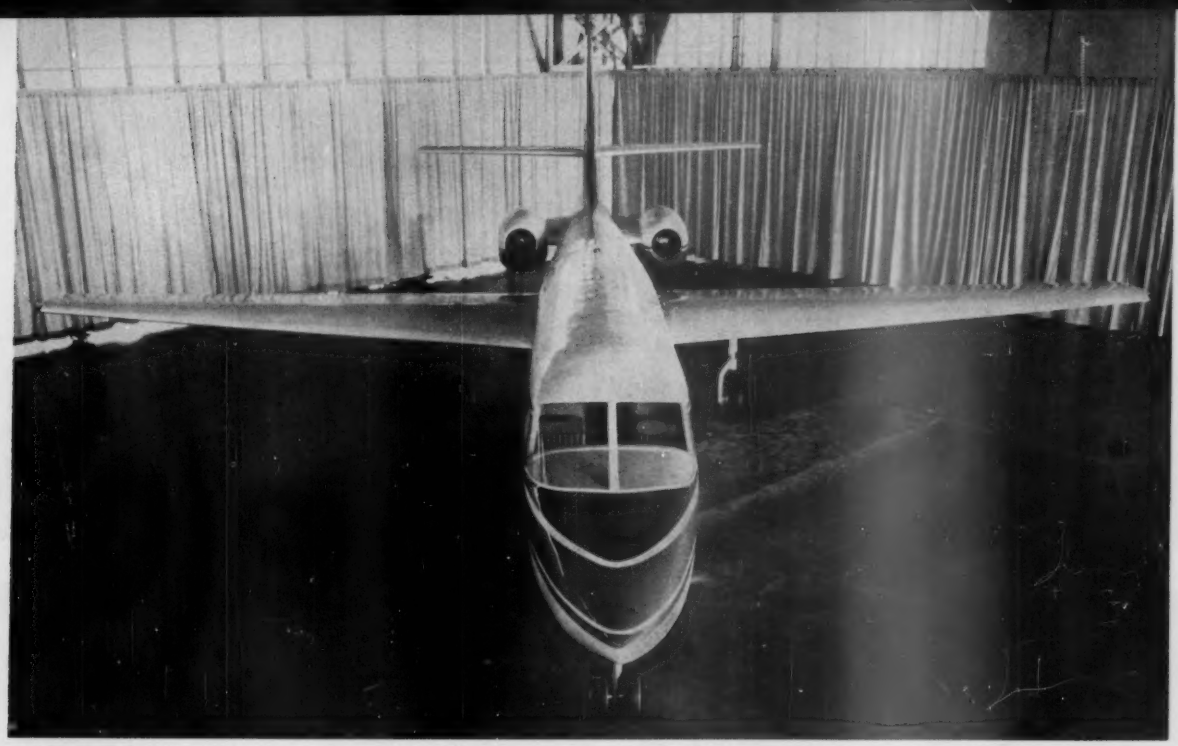
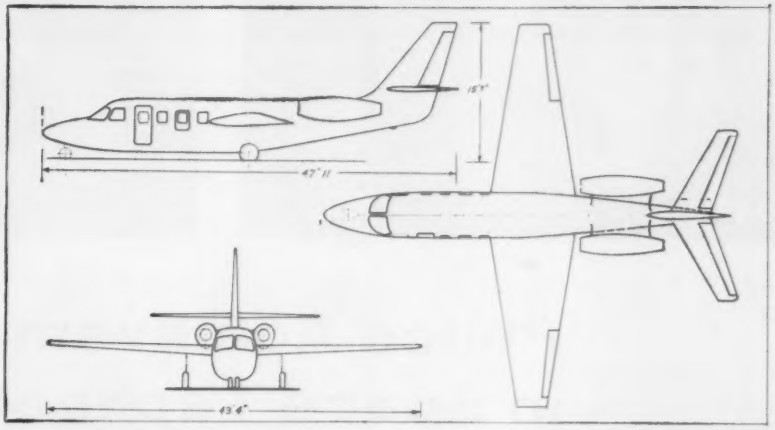
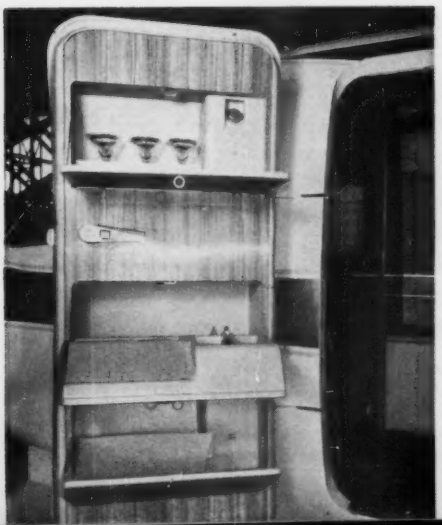


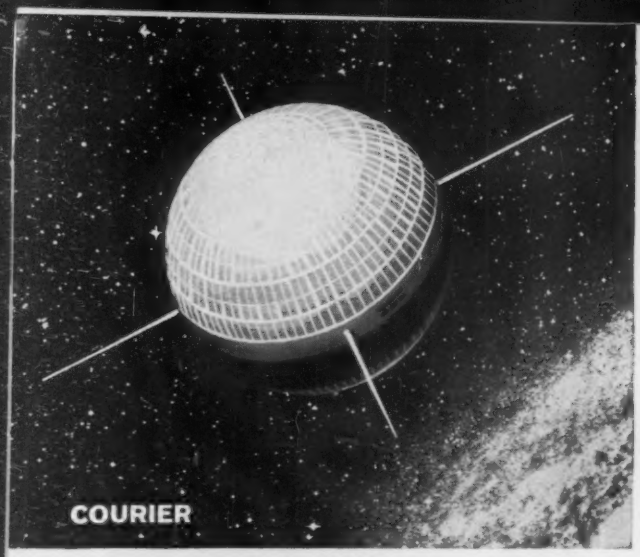
Jet Commander full-scale mockup is the tenth built in the course of making final the executive plane's configuration.

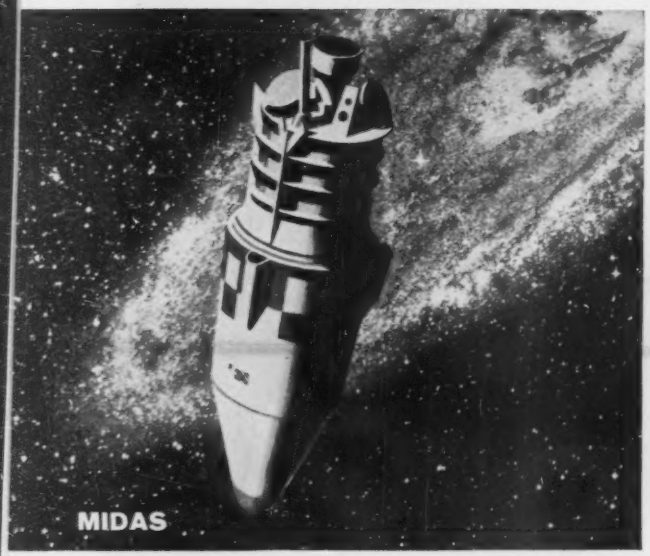
Mockup Shows Layout of Jet Commander Cabin

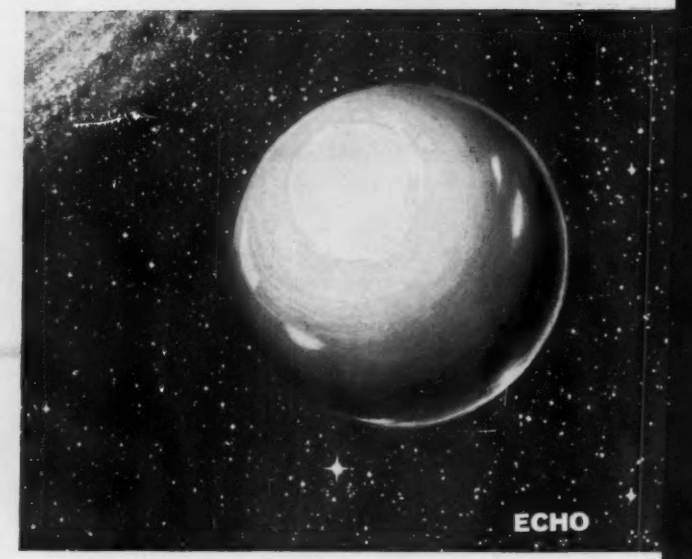
First components of the first two production prototypes of Aero Commander's Model 1121 Jet Commander (AW May 8, p. 92) are being built. Major assemblies probably will be mated by January. Three-view at right shows swept horizontal tail surfaces. Photo below, left, shows plug-type entrance door, pressure-sealed in flight, which will store drinking water (upper right of door) and passenger service items. It includes a wash basin. Separate mockup of cabin section (below, right) shows six-passenger seating arrangement. Center 14-in. x 15-in. cabin windows are jettisonable for emergency exit. The Jet Commander will sell for $560,000 including avionics, or $475,000 minus equipment.











Philco Achievements in Space Technology

Philco has made many major contributions to the nation's vital space programs. COURIER, the world's first advanced communications satellite, was designed and built by Philco. Philco played a major role in the development and installation of the complex communications, command, tracking and data systems for the DISCOVERER program. Space-borne and ground communications systems for MIDAS and other satellites have been Philco designed. Philco developed and installed the tracking and receiving systems for the Air Force Passive Satellite Relay Link, which utilizes the ECHO satellite. In the field of human factors engineering, Philco has developed personnel subsystems for several major space projects. Philco also produces the world's largest 3-axis satellite tracking antennas.

These achievements are dramatic evidence of Philco's ability to integrate its extensive resources to the design and production of the most sophisticated electronic systems. For capacity, facilities and experience in space technology, look to the leader . . . look to Philco.

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Air Taxi Operator Reports Traffic Gains

By Andy Keil

New York—Increased suburban air commuter traffic highlights the growing significance of Air Taxi Co., Red Bank, N. J., as a potent factor in that burgeoning market. The company cites new traffic records in revenue miles, revenue trips and passengers carried.

James Loeb, president and chief pilot of Air Taxi Co., reported that total revenue miles for the first quarter of 1961 were 137,685, up 32.9% over the same period last year.

Revenue trips totaled 1,657, up 19.9%, and passengers carried were 2,881, up 17% over 1960's first quarter —despite the heavy snowfall and inclement weather experienced during early 1961.

These percentage gains are highlighted against the 13,248 passengers carried to and from airline terminals Oct. 1959,-Sept. 1960.

Primary reasons for the increased traffic are:

• **Current trend** of industry to move out of congested cities into suburban areas remote from terminal airports.

• **Impatient business executives** demanding less travel time.

"Flying in and out of the suburban airports that surround metropolitan New York, air taxis can complete a journey for the airline passenger in a manner that gives real meaning to transcontinental jet speeds," Loeb said.

As a non-scheduled irregular air carrier operating under Civil Air Regulation 42, Air Taxi Co.'s shuttle service between La Guardia, Idlewild, Newark and Teterboro airports costs $18 in a Beech Bonanza or $25 in a twin-engine Piper Apache.

For 'off-route' traffic, Air Taxi Co. has established a zoning system extending 225 mi. from the New York area. With the Beech Bonanza, a flight within the 25 mi. zone would cost $18. The cost of a flight to the limit of their 225 mi. zone would amount to $112.50 in the same aircraft. Cost of trips of greater distances are estimated individually. Rates, which differ according to the aircraft used, are for the entire airplane which permits a maximum of 3 passengers in the Bonanza or Apache. Larger aircraft are available to Air Taxi on a lease basis.

NORMAL ROUTINE for Air Taxi Co. is the shuttling of critically injured or ill passengers who would find it extremely difficult to travel by other means of transportation.

Loeb now owns and operates a fleet of nine planes, six Beech Bonanzas, two Piper Apaches and one Piper Aztec. Air Taxi pilots must have a minimum of 1,000 hr. flight time plus a commercial license and instrument rating.

The average time of the 10 pilots now employed is 4,600 hr. with an accrued monthly average of 60 hr.

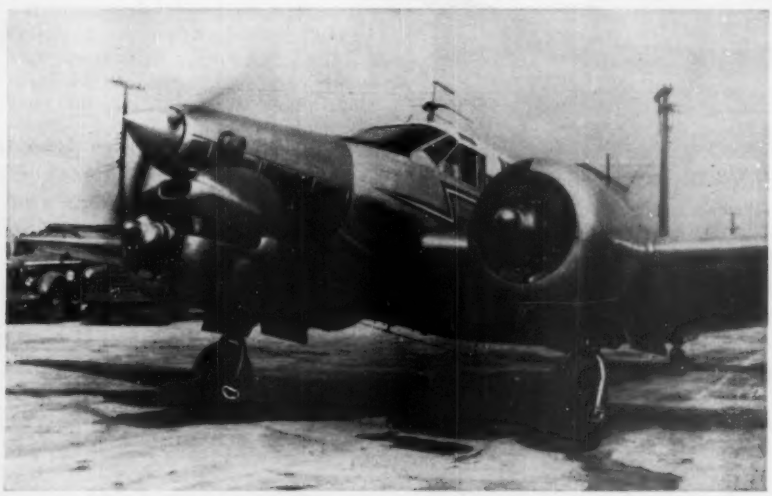
Corporate Contract Service

With this fleet of aircraft, Air Taxi Co. also is entering corporate contract service providing flight service 24 hr. a day, seven days a week to firms whose executives travel hundreds of hours a year to locations other than those served by scheduled airlines.

Corporate contract rates will be lower than regular Air Taxi single-flight rates and will be based upon a specified number of hours of flight time agreed upon by the user-company and the Air Taxi Co. Loeb believes the points in favor of the corporate contract plan are:

• **It is less expensive** for a company to make use of Air Taxi than to own and maintain a plane, hire a pilot and pay attendant charges.

• **It is less costly** to use a small Air Taxi in many instances rather than use



PT6 Installed in Beech 18

PT6 500-hp. turboprop Canadian Pratt & Whitney engine has been installed and run in the nose of a modified Beech 18 aircraft by de Havilland Aircraft, Downsview, Ontario. Flight test is scheduled at St. Johns, Quebec upon completion of ground-test program.

"Saved up to $5000 a month with our **BELL RANGER***"

*Taken from one of the many case histories in our file .. company's name on request.

What is an executive's time worth in making sales, closing contracts, supervising projects.. thirty, forty, fifty dollars an hour? Use a little arithmetic, and you can figure how substantial U. S. companies make their Bell pay.

Operating and maintenance costs of a Bell helicopter are low .. lower than any other make, class for class. And a Bell will fly approximately two years (often over 100,000 miles) without a major overhaul. Add these factors to time saved and the answer is, of course, profits.

Will unshackling *your* executives from slow ground travel mean *more profits* for your company? Let's discuss Bell helicopters and see. Just drop us a line. We will be glad to make a *Bell Analysis* of your business to determine if a Bell will pay its way, or if it is smarter for you to charter a Bell. No obligation of course .. just write: Commercial Sales Manager, Dept. 313E, P. O. Box 482, Fort Worth, Texas.

BELL HELICOPTER COMPANY

FORT WORTH, TEXAS • A DIVISION OF BELL AEROSPACE CORPORATION • A TEXTRON COMPANY

MFI Junior Developed in Sweden

MFI Junior, all-metal two-seat touring plane built by AB Malmo Flygindustri of Sweden, is powered by a 75 hp. Continental engine and has a maximum speed of 143 mph. and a range of 620 mi. The aircraft has a basic weight of 595 lb., is 16.8 ft. long and has a wing span of 21.6 ft. It will sell for under $6,000.

a larger, more expensive company-operated plane with wasted seating capacity.

• **Air taxis can be utilized** for transportation to and from suburban fields that cannot be utilized by scheduled airlines or large aircraft.

All Air Taxi aircraft are fully instrumented for IFR flight, including two-way radio, automatic direction finders, Omni receivers and a minimum of 90 channels for communication. Direct radio contact at all times is maintained with the Air Taxi base dispatcher as well as with the U. S. Weather Bureau teletype.

Licensed by the Civil Aeronautics Board and further approved by the Federal Aviation Agency, Air Taxi Co. must also conform to the regulations of the National Air Taxi Conference which establishes minimum flight operating standards and passenger-comfort facility standards.

Also, in conformance with the standards prescribed, Air Taxi Co. carries a minimum per seat liability of $100,000.

Cessna Skyhooks Sold Out Until Next Year

Dallas, Tex.—Cessna Skyhook rotary wing aircraft production currently is sold out for the remainder of this year and part of 1962 under present schedules.

First six aircraft, which were refurbished former Army YH-41 Seneca reconnaissance machines, have been allocated to dealers, with last of these to be delivered June 1.

First commercial production Skyhook will go to Cessna distributor Larry Hunt, Long Beach, Calif., who is getting a total of six initially, three demonstrators and three for firm retail customers. Price of basic Skyhook is $79,960.

Three of the former Army versions are being operated by Helicopters, Inc., Denver, Colo., on spraying, forest patrol, power line patrol and missile site support. Helicopters, Inc., has accumulated some 800 hr. so far on its Skyhooks.

Cessna is making a nationwide demonstration tour with two Skyhooks, planning 52 stops on the East and West Coasts, finishing up in the latter part of August. Company also is organizing factory-approved schools to train customer and distributor-dealer pilots and maintenance personnel, with classes starting Aug. 1. School will utilize a full-scale Skyhook mockup cutaway to detail equipment.

Cessna Inaugurates Time Payment Plans

New time payment plans permitting purchase of a Cessna 150 for only $750 down or a Model 172 for $995 down have been inaugurated by Cessna Aircraft Co. Designed to spur sales, the new plan will make it possible for potential customers to purchase a new airplane with a down payment costing only a few hundred dollars more than it costs them to get a private license. Cessna dealers for the past three years have been offering free flight training

"CONSULT THE AUTHORITY!"

Raymond Atchley Division
AMERICAN BRAKE SHOE CO.

GSE SERVO SYSTEMS
INDUSTRIAL SERVO SYSTEMS
AERO/SPACE SERVO SYSTEMS

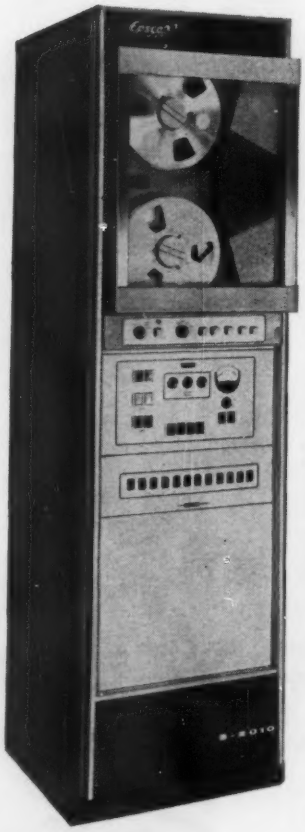
Since its inception, Raymond Atchley has developed many servo systems for both the military and industry . . . from missile controls to industrial automation. Years of experience in servo components and systems has been responsible for numerous and unique control systems. Atchley's research and development staff is currently investigating several new, promising control techniques for both aircraft and space vehicles. If it's a system involving electronic, hydraulic or pneumatic servo controls, consult Atchley.

Raymond Atchley Division
AMERICAN BRAKE SHOE COMPANY
2339 COTNER AVENUE, LOS ANGELES 64, CALIF.

ATCHLEY'S Jet-Pipe SERVOVALVE
. . . operates despite contamination

Atchley's servovalve is famous for continued performance . . . at unprecedented levels of contamination up to 25 times normal rate. Its exclusive Jet-Pipe feature makes this possible. Contamination is removed as a factor in reliability. Available in flows, one to 60 gpm; miniature models up to 1¼ gpm.

IN HIGH-SPEED DIGITAL PROCESSING
EPSCO DELIVERS ITS SPECIFICATION



DATA REDUCTION PROBLEMS?

NEW **S-2010** COMPUTER FORMAT RECORDER automatically records continuous incoming data in gapped computer format. Accepts any arbitrary data asynchronously or synchronously and at varying rates.

Epsco's new solid-state S-2010 is a universal recording unit which accepts digital data from a wide variety of sources and records it on magnetic tape in any specified digital computer format.

Used in conjunction with a digital output data gathering system, the S-2010 automatically processes data into computer-acceptable form, saving hundreds of man-hours of data reduction and hundreds of computer translation hours in reprocessing raw data into a form suitable for high speed computation.

As the data recording rate of the S-2010 is limited only by the maximum tape writing rate of the particular computer format, multiple channel data acquired at high sampling frequencies can be processed directly onto computer format magnetic tape.

Twin, coincident-core memories permit continuous incoming data to be recorded as gapped computer-format records with no loss of data. The S-2010 automatically generates all necessary gaps, parity bits, end of record, end of file and finish marks.

The S-2010 — a transistorized version of Epsco's famous vacuum-tube S-2000 — offers much greater compactness (1 cabinet instead of 3) and increased reliability.

A complete spectrum of standard options can be added to the basic unit to create systems exactly tailored to specific needs.

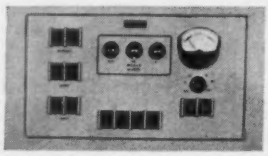
Write or call Epsco for S-2010 brochure.

SPECIFICATIONS

Memory: Two, alternating, 5μ sec coincident current core memories. Operates in push-pull mode for continuous data input; in tandem mode for intermittent data input. Plug-in memory modules of 256 characters each, available for expanding capacity. Choice of 256, 512, 768 or 1024 character capacity, in push-pull mode; up to 2048 character capacity in tandem mode. Choice of manual as well as automatic memory load. Memory verification read-out to line-at-a-time printer available.

Modes of Operation: Continuous or start-stop. Binary or BCD output. Variable record length control. Data programming. Self-checking test mode. On-line or off-line monitoring. Single or double memory operation. Data source control.

Construction: All solid-state, with quick-change, indexed plug-in circuit cards. Key logical elements have indicator lights, and all cards have test points brought out and identified.



Dimensions: Standard models, one standard 19-inch cabinet, 82" h x 22" w x 24" d.

Operating Environment: Temperature 32° F to 100° F, cooling by built-in ducting and blowers. Relative humidity: up to 90%. Altitude: up to 8000' above sea level.

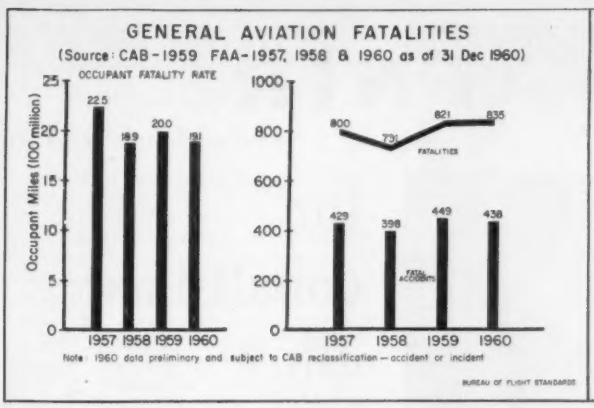
Thermal Dissipation: 2250 BTU (mean).

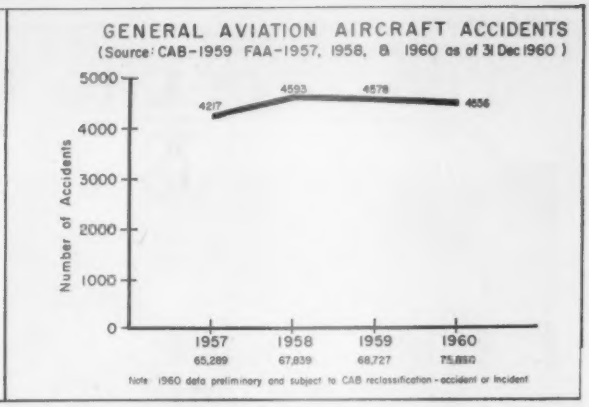
Power Requirements: 105 to 125 volts A.C., 60 cps. single phase, approx. 6 amperes.

Epsco

SYSTEMS

A Division of Epsco Incorporated, 275 Massachusetts Ave., Cambridge 39, Mass., UNiversity 4-4950




GENERAL AVIATION AIRCRAFT ACCIDENTS
(Source: CAB-1959 FAA-1957, 1958, & 1960 as of 31 Dec 1960)
Number of Accidents
4217
4593
4578
4656
1957 1958 1959 1960
65,289 67,839 68,727 75,850
Note: 1960 data preliminary and subject to CAB reclassification - accident or incident

General Aviation Accident Rate Drops

General Aviation fatalities per aircraft accident in 1960 showed an increase of 14 over the previous year, with 22 fewer accidents reported. In 1958, 4,593 accidents were reported, but the 731 fatalities involved only 398 accidents per 18.9 hundred million occupant miles traveled.

with the purchase of an airplane.

The Model 150 two-placer in the standard version lists for $7,495 and the standard version of the 172 costs $9,795—both flyaway Wichita—so under the new plan, down payment runs approximately 10% of list price. This percentage of list probably would hold in effect should the customer desire to add extras to his airplane.

Program is geared directly to the dealer, so payment scales probably would vary depending upon the particular arrangement worked out between individual customers and dealers. Some dealers and distributors have the capital to handle their own financing, some utilize local credit sources, and some is done through National Aero Finance Co., a wholly-owned Cessna subsidiary, or other national credit operations. Indications are that NAFCO will provide a four-year payment program.

PRIVATE LINES

Cessna Aircraft Co. announced that the Model 320, named the Skyknight, is now flying and will be introduced with the 1962 Cessna line. Aircraft, powered by two 260 hp. Continental turbosupercharged engines, will carry five passengers and will be capable of speeds up to 265 mph. at 16,000 ft. Price has not yet been announced.

FROM ENGINEER TO TEST CONDUCTOR IN 2 YEARS

QUALIFICATIONS
3 Yr. Missile Exper.
Presently Sr. Engr. or Equiv. in Design, Mfg., Flight Test, or Lab Component Testing
Demonstrated Leadership & High Mgt. Potential
Engineering Degree - pref. Mech., El., Physics, or Chem.
Current Base - At least $800/mo.
Age - 27-32, Married

PROGRAM SCHEDULE
FIRST Missile Test Mgt. Trg. Program

Free World's Largest Ballistic Missiles - Solid & Liq.

1961 J F M A M J J A S O N D | 1962 J F M A M J J A S O N D

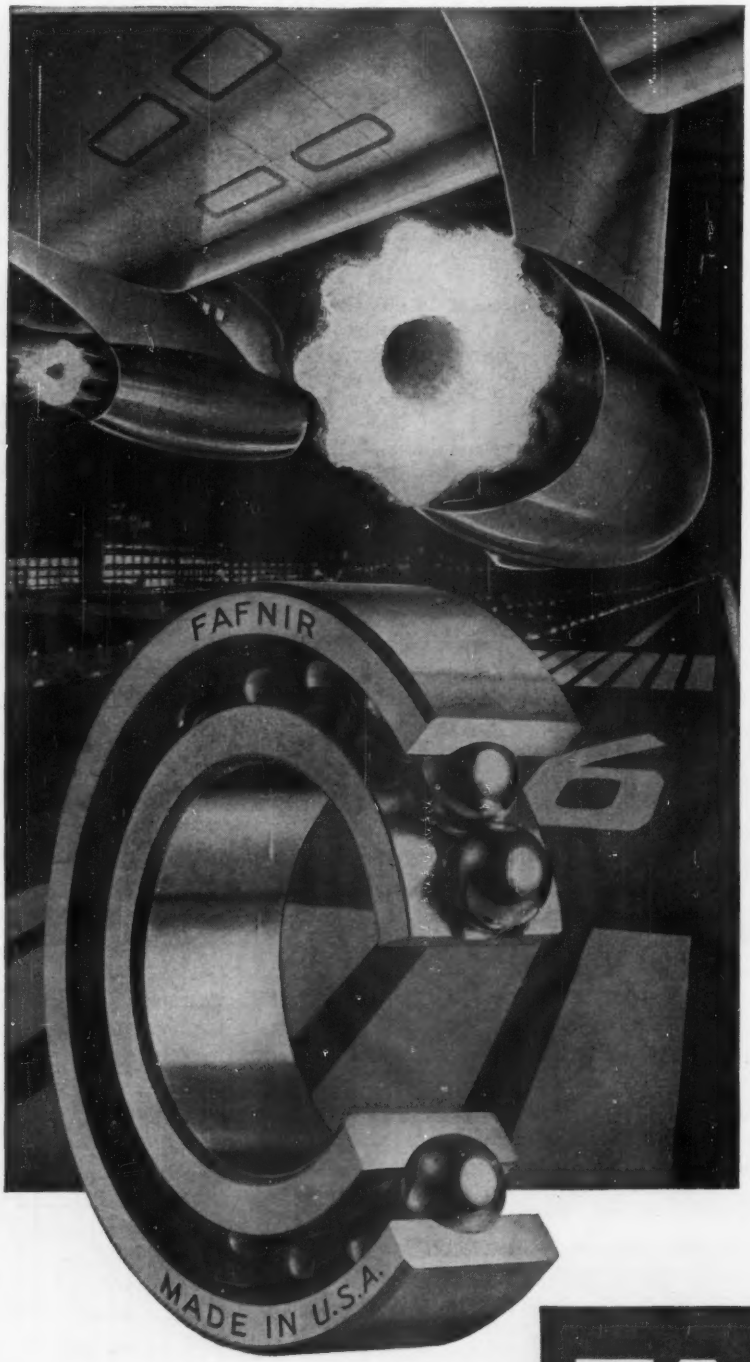
1 Work under Ld. Engr. in Mech. 5%
2 " " " " " Prop. 15%
3 " " " " " El. 10%
4 " " " " " P/C 15%
5 " " " " " M/S 10%
6 " " " " " Inst. 10%
7 Asst. Test Conductor 20%
8 Test Conductor 15%
9
19
20
21
22

Does your career plan call for progressing from Senior Engineer to Test Conductor in 2 yrs.?

Our Marketing & Mgt. Manpower requirements call for several additional capable missile men; hence, we have instituted this most progressive Missile Mgt. Trg. Program.

We are looking for the most capable young mgt. men in the Industry; hence, all qualified personnel are invited to explore in confidence this opportunity. Contact: R. E. Gabriel, Missile Mgt. Trg., Drawer M, Cocoa, Florida.

Look to **FAFNIR**



for cobalt-base alloy ball bearings that withstand high temperatures

Air bled from jet engines comes through *hot*. And the pressure is tremendous. For ball bearings that can stand these jet-hot heats and jet-high pressures, Fafnir turned to cobalt-base alloys. These "exotic" Fafnir bearings are ideally suited for turbo-drive butterfly valves and similar high temperature, high load applications. Look to *Fafnir* for leadership in ball bearings. The Fafnir Bearing Company, New Britain, Connecticut.

MADE IN U. S. A.
This stamp on a Fafnir Ball Bearing means finest quality and workmanship . . . dependable supply . . . competent engineering help . . . and responsibility in meeting your bearing needs. It's worth bearing in mind.

FAFNIR
BALL BEARINGS

WHO'S WHERE

(Continued from page 23)

Honors and Elections

Rear Adm. James L. Holland, Navy Medical Corps, has been elected president of the Aerospace Medical Assn. President-elect **Brig. Gen. Don Flickinger,** special assistant for bioastronautics to the Commander of Air Force Systems Command, will take office at the April, 1962, annual meeting. Other officers: **Dr. Charles I. Barron,** first vice president; **Robert Grandpierre, Eugene B. Konecci, Col. Spurgeon Neel,** USA, and **Dr. W. A. Prowse,** vice presidents; **Dr. W. J. Kennard,** secretary-treasurer; **Dr. Neal E. Baxter, Dr. James L. Goddard** and **Capt. Frank B. Voris,** USN, members of the council.

Awards made at the Aerospace Medical Assn.'s annual meeting included: The Theodore C. Lyster Award to **Air Commodore W. K. Stewart,** commander of the Royal Air Force Institute of Aviation Medicine; The Raymond F. Longacre Award to **Capt. Philip B. Phillips,** Navy Medical Corps; The Arnold D. Tuttle Award to **Lt. Col. Charles A. Berry,** USAF Medical Corps; The Eric Liljencrantz Award to **Capt. Ashton Graybiel,** Navy Medical Corps; The Louis H. Bauer Founders Award to **Lt. Col. Stanley C. White,** USAF Medical Corps and Chief of National Aeronautics and Space Administration's Space Task Group Life Systems Branch; The Harry G. Moseley Award to **Capt. Carl E. Wilbur,** Navy Medical Corps and currently assigned to Federal Aviation Agency; The Howard K. Edwards Award to **Dr. George J. Kidera,** United Air Lines Medical Director; The Walter H. Boothby Award to **Dr. John Eldrid Smith** of the FAA.

Changes

Dr. Luke Harvey Poe, Jr., assistant to the president of Aerojet-General Corp., Azusa.

Dr. Arthur H. Warner, director of Aerospace Corp.'s Cape Canaveral, Fla., office, has returned to Pasadena, Calif., to be a consulting engineer to Aerospace. **Morton Goldman** replaces Dr. Warner as interim director at Cape Canaveral.

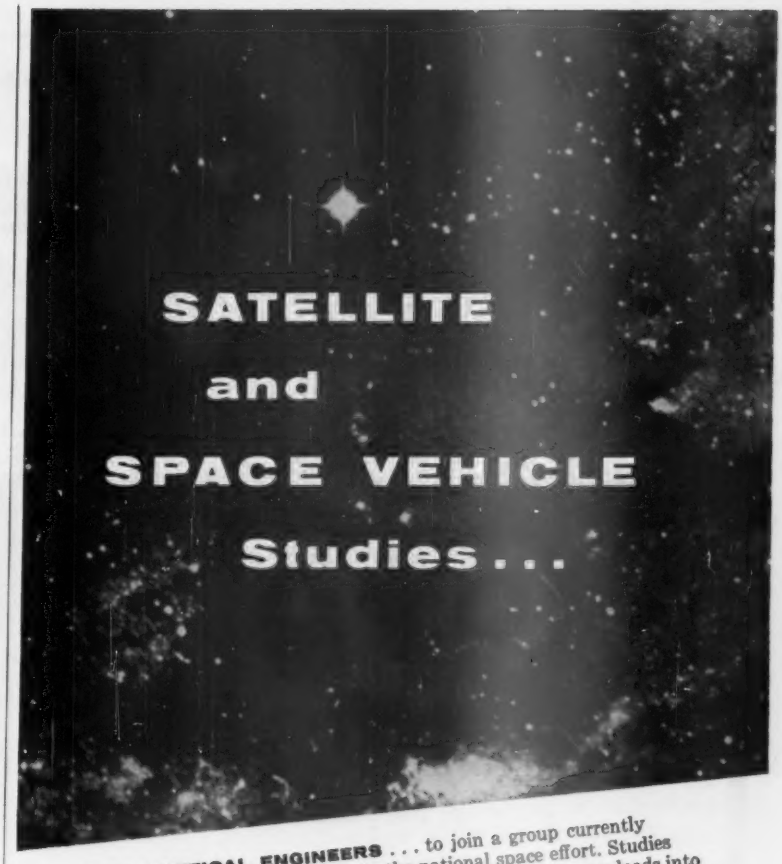
Capt. J. Robert North, director of the Naval Ordnance Test Unit at the Air Force Missile Test Center, replacing **Capt. James G. Franklin,** retiring.

E. Warren Feddersen, director of manufacturing development, Convair Division of General Dynamics Corp., San Diego, Calif., succeeding **J. H. Famme,** now assistant manager-operations at the Convair-San Diego Division.

J. A. Gorgenson has been assigned to the staff of the vice president-defense programs, Douglas Aircraft Co., Inc., Santa Monica, Calif. Also: **H. E. Bauer,** program manager, GAM-87 Skybolt weapon system.

Brig. Gen. George W. Goddard (USAF, ret.), special assistant to the president of Itek Laboratories, Lexington, Mass.

James M. Jans, chief engineer, General Chemical Division of Allied Chemical Corp., Camden, N. J. Appointed staff managers: **Robert G. Bierbower,** engineering administration; **John L. Ciba,** design engineering; **Charles W. Gaylord** and **James Jaffe,** process engineering.



ASTRONAUTICAL ENGINEERS . . . to join a group currently making significant contributions to the national space effort. Studies include determination of economical methods for boosting payloads into orbit; maximizing payloads for inter-planetary missions; determination of satellite arrays for full-time weather observations of the earth's surface.

Requirements include an advanced degree in Aeronautical Engineering, Astronautics or Mechanics with a strong background in Applied Mathematics. A knowledge of celestial mechanics is desirable.

PRELIMINARY DESIGN ENGINEER . . . for a group responsible for analytical studies of advanced vehicle concepts and their propulsion systems. Work will include the selection of structure types and estimation of structure and component weights for space vehicles, missiles, conventional aircraft, and VTOL's.

The position requires a background of experience with broad studies in which structural weights have been developed on a generalized basis. Advanced degree in Aeronautical Engineering preferred, although consideration will be given to a B.S. with extensive applicable experience.

Respect for individuality Our overall organization is small. Office areas are designed to provide an environment for mental concentration. Widely circulated technical reports bear the signature of those responsible for the study; publication of papers is encouraged.

Advancement opportunities are excellent within our organization and in the operating divisions of UAC. Attractive, too, are the salary levels, fringe benefits, relocation allowances, and the fully-paid graduate study program. Work is primarily corporate-sponsored with inherent personal stability. Typical of the facilities available to our staff is a computational laboratory that ranks among the largest in our nation.

Please write to Mr. W. D. Walsh, Personnel Department:

RESEARCH LABORATORIES
UNITED AIRCRAFT CORPORATION
400 Main Street, East Hartford 8, Conn.

All qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.

EMPLOYMENT OPPORTUNITIES

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

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Positions Wanted	Selling Opportunities Wanted	Employment Services
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TURBINE BREAK-THROUGH!

Once-in-a-lifetime opportunities for

EXPERIENCED ENGINEERS

in the field of

TURBOMACHINERY

Mechanical Design	Combustion
Fuel Controls	Heat Transfer
Stress Engineers	Experimental Engineers
Aero-Thermodynamics	Gearing Design

GIANT STEP: Solar has received one of the most exciting gas turbine development contracts ever awarded. This multi-million dollar project is for the development of a 600 hp turbine which will surpass piston engines in competitive applications, using principles and designs far beyond the current state-of-the-art. This—and a number of other new contracts recently received by Solar—will mean giant steps forward in extending the use of gas turbine engines, opening vast new fields for application by military and industry. Without doubt, this is a once-in-a-lifetime opportunity for qualified men. Act now.

SOLAR SPECIFICS: Solar is a pioneer and acknowledged leader in turbomachinery development, with more than 2700 gas turbines now in successful use. Established in 1927, Solar is a medium size company employing 1600 people, backed by the resources of International Harvester. Big enough to offer the finest opportunities, yet small enough so you don't get lost in the crowd. Solar is located in the sunny, seaside resort city of San Diego with the nation's finest year-round climate. Excellent recreational, educational and cultural advantages.

WRITE TODAY: Send resume of your qualifications to Louis Klein, Dept. E-722, Solar Aircraft Company, 2200 Pacific Highway, San Diego 12, California.

SOLAR
A subsidiary of International Harvester Company

All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

CONTROLS ENGINEER

M.E. or E.E. Experience in the analysis and design of feedback control systems and components. Work will include the use of analogue and digital computers for control of hydraulic and pneumatic systems. Experience and interest in digital and pulse control systems desirable. Please send resume to:

Salaried Personnel
VICKERS INCORPORATED
Division Sperry-Rand Corp.
Box 302
Detroit 32, Michigan

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NEW YORK 36: P. O. Box 12
CHICAGO 11: 645 N. Michigan Ave.
SAN FRANCISCO 11: 255 California St.

POSITION VACANT

Wanted—Pilot with former airline jet transport experience. Prefer aero engineering background. Send resume of experience and education, with references, to Safe Flight Instrument Corporation, Hangar D, Westchester Co. Airport, White Plains, N. Y.

POSITIONS WANTED

College graduate, BS Aeronautics major in Aircraft Maintenance Engineering desires position in corporate aviation. Resume on request. PW-6555, Aviation Week.

Navy MATS Pilot, 12,000 hrs. World Wide experience. Age 40. Family man. ATR DC-6 & DC-7. Requalifying DC-4 & DC-3. Retiring and available after June 1. Desires Corp. executive flying position. PW-6583, Aviation Week.

Executive Pilot—Chief Pilot past 7 years, 8,000 hours ATR, rated DC-3, Lodestar, A-26. A&P, Aero-Engineering degree. Resume sent on request. PW-6667, Aviation Week.

ATR Pilot—Extensive corporate and airline experience. Navy trained. Seeks demanding position. Resume on request. PW-6617, Aviation Week.

Airfreight Sales and Operations Specialist— 25 years diversified international and domestic experience all phases commercial transportation including distribution and rates. Interested in challenging position. Travel agreeable. PW-6672, Aviation Week.

Pilot-Engineer, seeks position to utilize experience in both flying and engineering. BSME, 2 yrs. Flight Test Engineer industry, 1600 hrs., Com. ASMEL, Inst., LFI, married, age 28. Need a "challenge" not a billet for a "warm body". PW-6636, Aviation Week.

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the box number when answering advertisements. It is the only way we can identify the advertiser to whom you are writing.

TECHNICAL QUIZ ON LOGIC CIRCUITS AND DIGITAL COMPUTERS *now available*

In May, 1960 General Electric's Light Military Electronics Department announced a new concept in professional job selection... in the form of a series of self-appraising technical tests covering the subjects of Radar, Microwaves, Electronic Packaging, Communications, and Administrative Engineering (a self-scoring psychological questionnaire).

To date, more than 7,000 scientists and engineers have written for and received one or more of these tests.

Now, LMED is pleased to announce the completion and immediate availability of a special new test devoted exclusively to the computer field. Developed with the same care and pre-testing as Light Military's other quizzes, the Computers test is also designed to be taken and scored for your self-appraisal only. The results need never be divulged to anyone – including LMED.

So, whether you're thinking about a change, or simply interested in finding out how you stack up against other engineers in your field, any of these tests should give you a sound, objective means for appraising your abilities – in about an hour, at home.

Mail this coupon for your tests, answer sheets & evaluation guides

64-WT

Mr. R. Bach
Light Military Electronics Department
General Electric Company, French Road, Utica, New York

Please send me tests (limited to 2 subjects per individual) answer and self-evaluation sheets covering the areas checked:

- ☐ LOGIC CIRCUITS & DIGITAL COMPUTERS
- ☐ RADAR ☐ MICROWAVE
- ☐ ELECTRONIC PACKAGING (ME)
- ☐ COMMUNICATIONS ☐ ADMINISTRATIVE ENGINEERING
- ☐ *"Have already received other LMED quizzes, but would like to get the test(s) I have checked above."*

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Home Address_____

City_____ Zone_____ State_____

Home Phone_____

Degree(s)_____ Year(s) Received_____

Current Areas of Activity at The Light Military Electronics Department

Space Communications and Telemetry • Missile and Satellite Computers • Space Vehicle Guidance • Undersea Warfare Systems • Thermoplastic Data Storage • Space Detection and Surveillance • Command Guidance and Instrumentation • Infrared Missile Applications.

LMED

LIGHT MILITARY ELECTRONICS DEPARTMENT

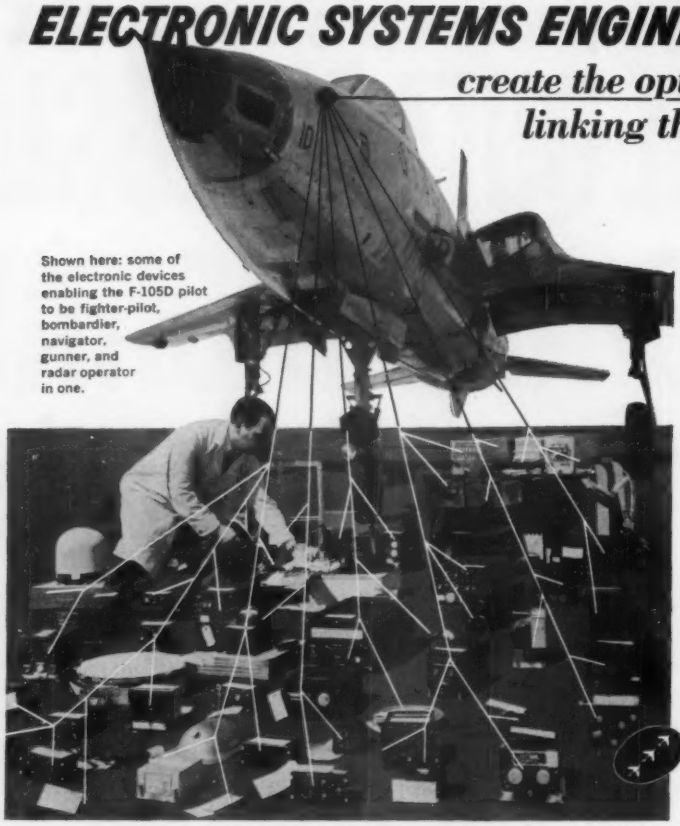
GENERAL ELECTRIC

FRENCH ROAD, UTICA, NEW YORK

All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

ELECTRONIC SYSTEMS ENGINEERS...

create the optimum neuro-pattern linking the electronic "brains" of Republic's F-105D



Shown here: some of the electronic devices enabling the F-105D pilot to be fighter-pilot, bombardier, navigator, gunner, and radar operator in one.

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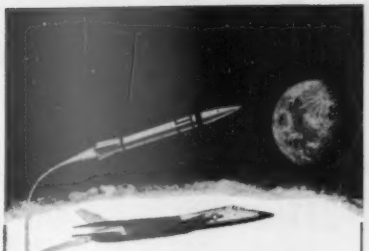

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COLUMBUS DIVISION
NORTH AMERICAN AVIATION

LETTERS

Enemy Capabilities

With respect to Mr. John R. Tyler's letter (AW March 27, p. 114), concerning Gen. Irvine's recent economic study, I noted one point that deserves comment.

Regardless of my opinion on the Irvine plan, I must take strong issue with Mr. Tyler's questioning the need for a national plan. Criticism of the details of a proposed national plan is one thing. Questioning the validity of pursuing the formulation of a long range national plan is an unfortunate form of static thinking and tunnel vision that prevailed in this country up to 7 December 1941. Mr. Tyler's reference to the Sino-Soviet logistics problem as one to remain static for some time has a unique historical parallel in the pre-war attitudes of Senator Burton K. Wheeler, French military confidence in the Maginot Line, and the prevailing American public attitude that "We could beat the Japanese any day before breakfast." Nevertheless, to our complete amazement, the German military machine proceeded to demonstrate what a blitzkrieg is, the Japanese entered the war with 35 kt. destroyers (Amatsukaze class) and the best tactical fighter in the air (Zero) other than the Messerschmitt-109. Mr. Tyler may confirm this statement with any CVA-19 officers who flew F4F Wildcats throughout 1942. Even though we ultimately won, we were generally unaware of the weapon advances potential aggressors had developed throughout the '30s, and we failed to develop suitable counter weapons.

The lesson to be learned is that the military posture of a potential aggressor at any single point in time can never again be looked at as a static one. It must, if we heed the lessons of history, be looked at as a transitory phenomenon. This necessitates the need for long range planning for the purpose of anticipating the aggressor's future position and implementing long lead time requirement programs in order to assure ourselves a reasonable position when the need becomes critical.

I sincerely hope that Mr. Tyler never has to look down the throat of a Russian ICBM or IRBM from the deck of his CVA. If he does, I hope he is properly grateful for the anti-missile missile that will shoot it down and realize that national long range planning foresaw the need and provided such a counter weapon.

R. S. Couey
Fullerton, Calif.

Restrictive Security

Can't something be done about the inadequate, completely frustrating, and self defeating anachronism known as our "security system?" Paraphrasing the famous French Revolution death cry: "Oh, security, what crimes are committed in thy name."

Anyone can get a rubber stamp reading "Secret" and stamp the Ladies Home Journal and it becomes a classified document, but it requires an approximation of a Constitutional amendment to de-classify it. Once classified the possessor must guard it with his life, even though he knows its relationship to actual national security may be so remote as to be nonexistent.

Why not date the classification on a document and make it automatically declassified at the end of a year, if not renewed? Also, some type of government seal imprint should be required to make the classification valid.

In a new location within the same company I have been, for over four weeks and still waiting, bogged down in buck-passing and security paper work for the locksmith in our organization to issue me a security-approved padlock for this so-called classified material, much of which if wrung out should be in the wastebasket. But my neck is out if I fail to find someone who has a lock to lock it up at the end of the day—after several weeks, all your neighbors hate you.

A recently released study on the "Structural Analysis of Rocket Motor Cylindrical Bodies and Spherical and Elliptical Heads," gave absolutely nothing new. (It's all in my 23-year-old edition of "Formulas for Stress and Strain" by Roark.) What it said was so interwoven with gobbledygook (padding) and unnecessary, abstruse mathematics as to thoroughly confuse an astute scholar. It took me several hours to discover that the author was saying nothing, in the most involved and complicated manner. (Of course, individually it didn't cost me very much; Uncle Sugar's nephews and nieces paid for the report, and for my and several others' time reading it.)

I cite this to show how our present system provides a beautiful shield for nincompoops and ne'er-do-wells to hide behind and an ideal place for domestic traitors to tie up our slim scientific manpower in useless, time-consuming endeavor, thus slowing up our whole operation. If I were a Communist this is the way I'd work, and how could our security system stop me?

Our approach to security should be on the basis of a calculated risk. If in doubt as to whether a document should be classified, don't! It would hamper us almost as much as the Russians. With them admittedly ahead of us in some important fields, some risk would be in order to unhobble our own efforts so we can start running again.

A short time back a young engineer went to work for me. He told me that when he first went to work for his previous employer he invented a new-type, much-needed valve for a certain rocket. His initial layouts were submitted for approval and promptly stamped "Secret." It was three days before he could gain access to his own work, because he only had an interim "Confidential" clearance.

The "need to know" philosophy is another aspect of security sadly in need of revision, if we want to get back into high gear. Every engineer and scientist worth his salt is "knowledge-hungry." Prior to World War II we couldn't stay abreast in our profession if we weren't. Many of us carried "little black books" of technical tidbits garnered without any "need to know" because sometime they might be useful. Sometimes the best solution to a problem comes from another unrelated field of which there is no apparent "need to know."

We must face it; a perfect security system would guarantee absolute immobility in the arms race, and would maintain a stagnant status quo of scientific knowledge. While we are not quite bogged down, it is becoming apparent why the Russians got ahead of us. Nearly all progress today is in spite of the security system, and in any race rapid progress wins—not maintaining a fixed position.

Engineering society meetings that 20 years ago were live forums of current knowledge have degenerated to tiresome rehashes of old stuff read six months ago in Aviation Week. Of course, some of the secret sessions are good if you knew three months ahead that you could get away and got your "clearance" in the security mill in time.

Why cannot clearances be on an individual rather than a company basis? A clearance card and social security card could be combined with thumb print and picture with only two levels of clearance, "cleared" or "not cleared," these cards to be rechecked at specified intervals (one year—two years —?) on the individual's responsibility—like a driver's license. Then to attend classified sessions he'd simply present his clearance card. Sure, it isn't airtight, but neither is our present system. At present if a Commie was told to attend he'd leave no stone unturned to finagle his way in, whereas the engineer who should go gets so bogged down in security procedures (which continually change) that he gives up in disgust. Now who has benefited?

This letter can be easily pooh-poohed and degraded in importance by those who don't understand or are interested in maintaining an outdated status quo, but the facts remain very real for those who must work under the system. Since some system is necessary can't it be streamlined and get it off our backs so we can accomplish something?

(Name withheld by request.)

An Old Timer
California

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Overheard?

In regard to the last item in your "Industry Observer" column, May 1 issue (p. 23), I believe the USAF research effort has laid an egg.

The item relates that USAF is planning to use a recording of a woman's voice as an audio warning of danger by introducing an "unusual" sound to attract pilot attention.

I would think that little research is necessary to determine there is nothing unusual about hearing a woman's voice.

Ralph G. Tuttle
Bethesda, Md.

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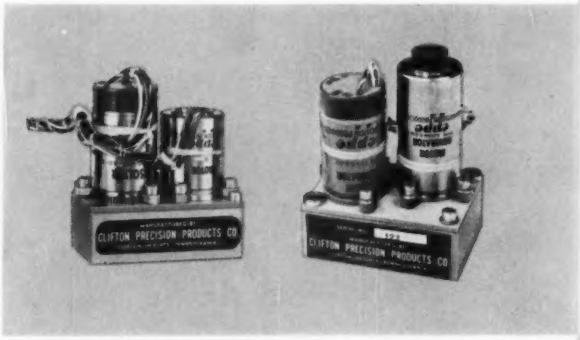

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